THE
Control Universal
CATALOGUE

May 1987
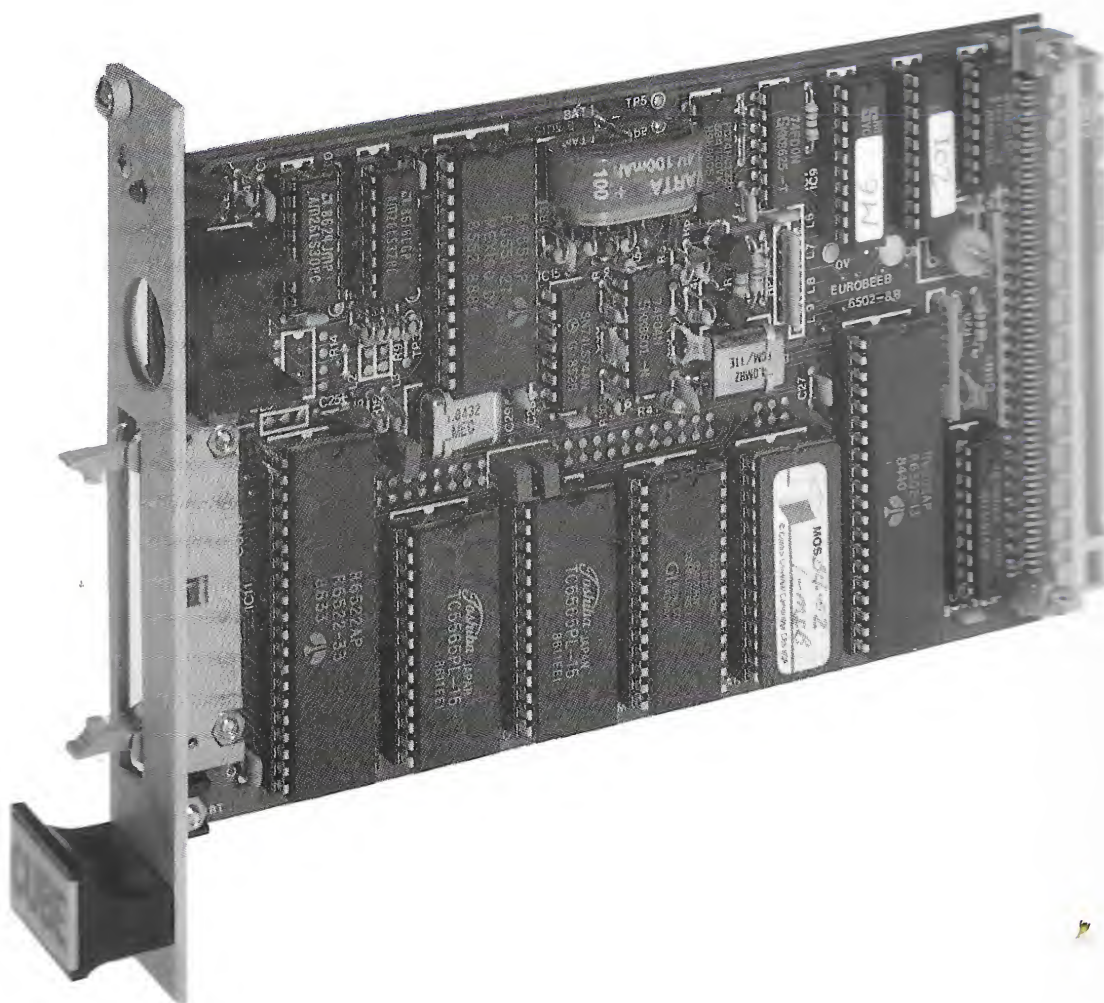
Customer Support

## Customer Support
since 1978

Control Universal has been supporting its customers in the application of microprocessor technology to industrial control and monitoring systems for the past nine years. An experienced team of 50 people are available to provide the depth of product support which has built Control Universal into the largest manufacturer of single height Eurocards in the UK.

Customer Support
in your Area

Our team of Sales Engineers, based around the UK, are able to advise you on the application of Control Universal products, saving time and money when you need a solution to your requirements on the spot. (**Where's my engineer ?** See inside back cover).

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WestArea	Ken Fullbrook	
Central Area	Mark Hassell	
East Area	Mark Portlock	
South East Area	Dennis Murphy	

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in Cambridge

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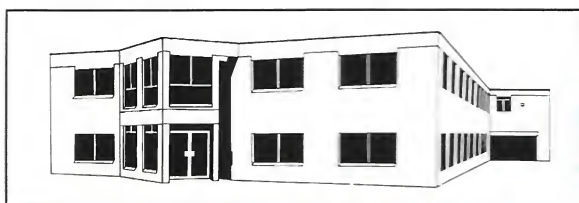**Lesley Kiln**, Sales Desk

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CUBE
The Integrated Control Environment
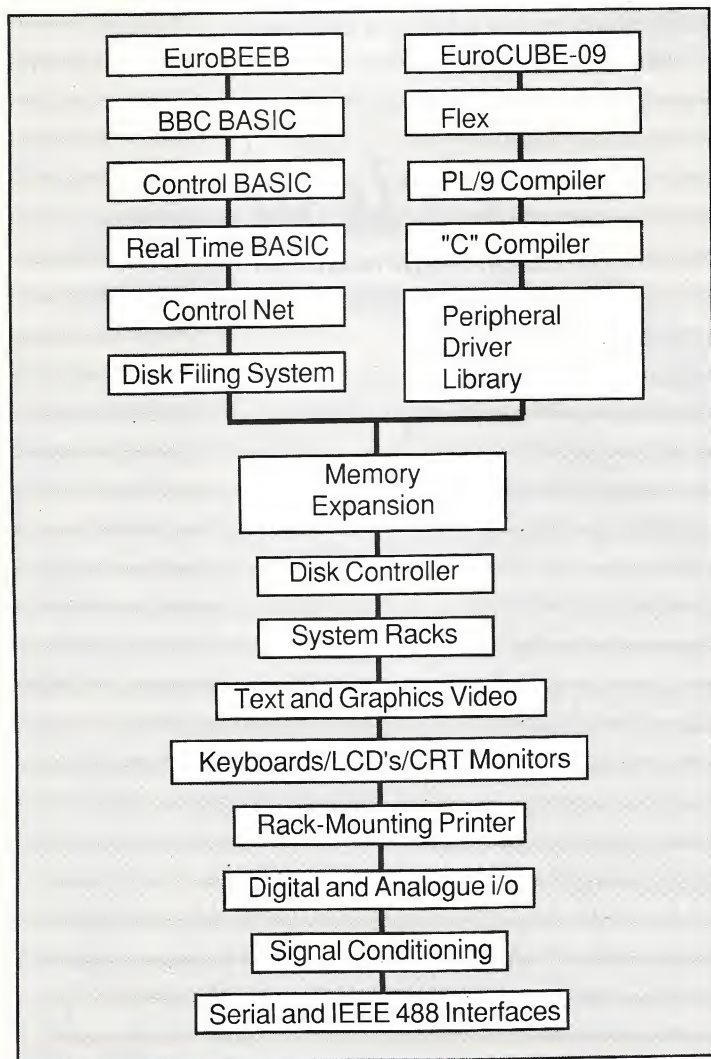
Celeste
High Performance on STE

Welcome!

Welcome to Control Universal's new catalogue in which we have produced a publication which is easy to use, informative, and a practical quick tour of the capabilities of the CUBE and Celeste ranges.

Celeste

Celeste is the name of Control Universal's new range of STE bus cards. We have chosen STE for our high performance range, which commences with two advanced microprocessors, the 68008 and the 80188, a high resolution graphics processor card based on the 63484, an intelligent FDC, a 1 MB DRAM card, and a range of support hardware and software for applications development.

The advantages of STE are discussed in more detail on page 17, as an introduction to the section on Celeste. It is a high performance bus, with backplane frequencies of 16 MHz, 1 MByte of memory address space, direct vectored interrupts, and the capability of supporting multiple processors on the same bus, with in-built arbitration. Nonetheless, this is achieved at minimum complexity, allowing full technical understanding at user level, and the expectation of successful user implementation of his own special cards to full STE specification.

CUBE The Integrated Control Environment

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You will see from the following pages that the CUBE range has benefited from substantial further extensions in function and performance, both in hardware and in software terms. The essence of CUBE is its integrated approach to Control and Monitoring Engineering.

Control Universal have a huge installed customer base using our CUBE bus. Our existing satisfied customers are our greatest asset, and we will continue to develop the CUBE bus to achieve ever greater convenience in use, which is our main objective with the product range, and justifies our claim for

"The Integrated Control Environment"

Total Support from Control Universal

Our definition of Total Support includes:-

> High Quality product made under strict QA procedures
>
> First Class Technical Documentation
>
> Technical Support always available to you at Cambridge by phone or visit
>
> Regional Sales Engineers at your service

Make or Buy - The CUBE Advantage

In addition to the convenience and performance of the CUBE range, Control Universal offers you an interesting economic proposition, which is intended to keep the balance of advantage continuously and convincingly on the side of buying from us rather than making your own equipment.

This is achieved by an exceptionally steep discount structure, which keeps the purchasing cost well below the cost of design, tooling, documentation and manufacture. But there are more advantages in buying, namely:-

- *timescale* - your project reaches completion sooner with a product that is ready to use

- *certainty* - using proven, fully documented products, there is no need for "fudge" factors in terms of performance, price or timescales - you know what you are getting

- *maturity* - CUBE products are the result of an iterative process that takes the design through several stages, culminating in an optimal solution - in-house designs usually cannot afford the time or expense of this evolution

- *resources* - if your engineers are freed from the task of designing the system building blocks that CUBE can supply, they can concentrate on those parts of your project that only your company's specialist skills can tackle

The CUBE discount structure (which applies also to Celeste) offers a number of ways that discount can be applied, so that each individual customer can buy in the most efficient and cost effective manner. Please contact our Sales Manager, or one of our Regional Sales Engineers, for more information on our discount structure.

For quantities above 100 pieces, our special design service can further improve unit costs. In these higher quantities, we are also prepared to consider supplying bare pcb's if this provides you with economic advantages.

Placing Your Order

Order Enquiries. Please contact Rosemary Toull our Customer Service Supervisor, for any queries on outstanding orders. **Call Cambridge (0223) 244448.**

Standards and Non-Standards. This catalogue contains the CUBE and Celeste range of standard products at the time of going to press. Naturally, there will be changes in the course of the currency of this catalogue as new products are released and existing ones enhanced. If you don't see what you want, please ask. We are glad to provide variations on the standard theme by special quotation.

Special Products to Your Requirements. Most of our larger customers require some degree of specialisation as only then is the exact fit to needs achieved when the economies of scale justify the extra effort involved in a special. We shall be pleased to work with you in establishing your needs and quoting for an optimal solution.

Previous Versions of Products. We will quote for the supply of products which are no longer current, as we do understand that in some instances, eg. for spares purposes, customers will not want the upgraded version.

Variations of Board Population. We no longer supply the multiple variations of boards which can have different populations of memory chips and i/o chips, as in CU-MEM and CU-MEM Selecta, and CUBIO. Instead we offer the fully tested board, complete but without the chips whose quantity might vary, which are then listed individually for the customer to plug in as required. Where calibration is required, e.g. as on CUBAN-12B, the policy of offering all options fully built is retained.

Technical Manuals. Each card ordered at full price is supplied with its own manual free of charge, and only in special cases is there a charge for a product manual. All manuals are available separately (see page 20) and qualify for the same discount structure as Eurocards. The steep discount structure operated by Control Universal provides for bulk purchases to be made economically. In such circumstances a technical manual supplied with each card would probably be wasted. Consequently, technical manuals are included only with products ordered at full price and not when discounts are given.

CUBE Consultants

Industrial Computer Consultancy Service from Control Universal

Wide Ranging Software Engineering Service

Applications programming of Cube and Celeste Systems

Modifications of standard products to special needs

On-site Systems Installation

Operational Documentation

Programmer and Operator Training

Software Quality Auditing

Control Universal Ltd have been providing industrial control and monitoring solutions since 1978, which has often included a strong element of software and hardware customisation. Cambridge Microsystems, an independent software house since 1981, with considerable experience in the use of CUBE systems, have now been absorbed into Cube Consultants. They bring with them a wide range of software skills over a variety of processors.

Software Engineering Service

Projects Completed:	Systems Supported:	
Operating System Development	6502	6809
Device Driver Packages	Z80	8088
Networking	8086	80188
Communications	68008	68000
Public Display System	32016	
Metering System	GEC 4000/6000	
Compiler Development		
Spreadsheet Development	CUBE MOSB, MOSF	
Hardware Test System	All Acorn/BBC Systems	
Ticket Issuing System	MS-DOS	
Navigation System	OS9/68K	
Totaliser System	Panos	
Turnkey Applications	UNIX	
	GEC OS4000	

Applications Programming: For those organisations wishing to program their control and monitoring equipment but whose resources are otherwise committed, this service will provide:-

Production of a detailed operational specification

Agreement of implementation deadlines

Writing, testing and documentation of the application program

Customization of Standard Systems to Special Needs: It has been our experience that many customers find that Control Universal computers satisfy the majority of their requirements, but that certain specialised modifications would improve the suitability of the equipment for the task. Cube Consultants will undertake to provide modified versions of standard units to meet specialised needs, so combining the economy of standard products with the full suitability of customised engineering.

On-Site Installation: By entrusting the on-site installation to Cube Consultants, the customer is extending the responsibility of Control Universal to ensuring that the system works in its installed environment. Use of this service allows projects to start operation earlier by using engineers experienced in this work.

Operational Documentation: Whether or not Cube Consultants has installed the system, the provision of operation documentation, written in easy-to-follow language, enables customer's staff, responsible for operating and maintaining the system, to have the best possible tools for performing their tasks effectively.

Programmer and Operator Training: Control Universal have been running successful training courses for customers for some considerable time. These courses are arranged on an as-required basis. They can be arranged either specifically for one customer, to be held either at Cambridge in our well-equipped conference centre, or can be set to suit several organisations with compatible requirements. Further details of courses, together with suggested topics, are given on page 20.

Third Party Equipment: Cube Consultants also offer their services with respect to equipment other than CUBE and Celeste. The Consultants are experienced in a wide range of other computers and operating systems - see list above.

Software Quality Audit: A particular strength of Cube Consultants is a comprehensive Software and Firmware Quality Audit service. Quality Audit is a vital element of effective Quality Assurance. It is provided on or off-site with complete confidentiality, by software engineers experienced in this type of work. (First class reference can be provided.) The scale and scope of the audit activity is defined by the customer. Examples include "Black Box" testing against a requirements specification and/or user documentation, or a detailed "Bottom Up" test against the product design specification.

EuroBEEB - the practical control system for engineers

EuroBEEB Single Board Computer

Specifically designed for laboratory and industrial control and monitoring, the EuroBEEB range is robust and easy to use.
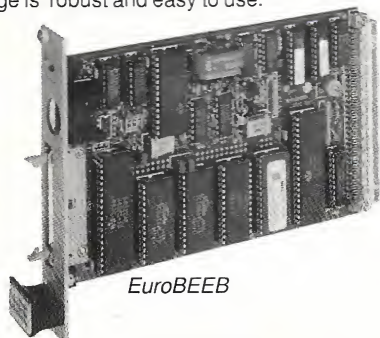
EuroBEEB

Features:
65C02 processor
BBC-compatible operating system, MOS4C *
BBC BASIC, expanded by Control BASIC *
Extendable with **Real Time BASIC** and **Control Net** *
8kB RAM expandable to 16kB *
User program EPROM up to 16kB   } (both need EPROM
Auto-run on power-up facility   } programmer)
Link-selectable 1 or 2 MHz CPU clock frequency
On-board real-time calendar clock *
Battery back-up circuit for clock and CMOS RAM *
Buffered RS422/RS423 serial port *
16 digital i/o lines plus 4 control lines
On-board timer
Complete with front panel and LED power indication*

EuroBEEB is supplied complete with a BBC Micro compatible operating system and completely standard BBC BASIC, extended by Control BASIC which adds commands for the control of i/o and time. Typical Control BASIC words include TURNON and TURNOFF, which directly control digital outputs, ADVAL and DAC which control analogue inputs and outputs, CLOCK$ and DATE$ which are used with the on-board battery-backed calendar clock.

EuroBEEB can be used on its own, or in one of the racks described later, together with any of the CUBE range of peripheral cards. Peripheral driving software included in the development pack allows convenient control of all the extension cards such as video, analogue i/o and serial ports.

Programs may be developed on the EuroBEEB on its own, or by using the BBC Master or Model B, or an IBM PC compatible. See "Developing EuroBEEB Applications" in next column.

BASIC IV. As standard, under licence from Acorn, the fully populated version of EuroBEEB is supplied with BASIC IV, the most powerful implementation to date of BBC BASIC. A comprehensive 150 page manual is available at a cost of £25.00. (It is inclusive in the price of the development packs.)

Real Time BASIC extends the power of EuroBEEB still further by providing the means to deal with unscheduled events of the kind normally encountered in real-world control situations. This is described in further detail on page 5, and in the data sheet available on request.

Control Net allows up to 256 EuroBEEBs to communicate with a supervisory unit which may be another EuroBEEB or a BBC Master or Model B. This is a full error-checking system designed to be exceptionally easy to use. Further details are shown on page 5, and a data sheet is available.

EuroBEEB Single Board Computer, complete, with 8kB RAM	CE663BM	£295.00
BASIC IV Manual, (150pp+) (not supplied as standard)	CB657TA	£25.00
EuroBEEB without BASIC, MOS or RAM	CE661CU	£225.00
EuroBEEB Economy version without starred (*) items in features list above	CE662CU	£127.00
Additional 8kB RAM chip, type 5565	CP008RA	£6.00

£69.85!

The special price of the Economy version of EuroBEEB in 100+ quantities is £69.85 for a full-size Eurocard unit with bus interface capable of driving a full rack of other cards

Developing EuroBEEB Applications

The recommended way to develop a EuroBEEB application is to first consider whether a standard packaged system will be suitable, as these are ready to use and cheaper than the combination of parts. (See pages 10-11 for "Packaged Systems".) If a standard system is not suitable, then you can specify your own combination of cards with your particular application in mind.

If, for example, the required final application needs a video display, a full QWERTY keyboard and at least one disk drive, then no other equipment is required for development - this configuration is capable of performing the full program development. (See page 8 for "Configuring Rack Systems".)

If the target does not include all these items, you should next consider what equipment you have already. EuroBEEB development can be performed using any one of the following:
BBC Micro Model B,
BBC Master
IBM PC, XT or AT, or any compatible machine

The units above must all include keyboard, video display and disk storage. If the EuroBEEB target application includes a disk drive, the development can be performed using a standard serial terminal to provide the keyboard and video.

Whichever method you choose to use, in development you will almost certainly need the EuroBEEB to have 16kB of RAM, (ie. the standard product shown opposite will require the extra 8kB RAM chip). You will also find it useful to have 32kB of RAM available, which will involve having an extra memory card such as CU-MEM or CU-MEM Selecta with linear RAM. This way, programs up to 16kB long can be developed and transferred to a 16kB EPROM. The target system will not need the extra memory card once the program is in the EPROM.

You will also need a development pack, of a type appropriate to the development method chosen. Each pack contains the BASIC IV manual and AutoMOS software (AutoMOS4C) facility which allows the user to configure his operating system to deal with his choice of peripheral cards - when configured, a new version of the operating system is blown into EPROM and replaces the one supplied. An EPROM programmer is needed for this purpose. CU-PROM II is recommended (see page 16), although any programmer can be used, provided that will blow a 27128, and which connects to the development system you have chosen to use.

The development packs for the BBC and the IBM also contain a serial cable and software to convert the BBC or IBM into a serial terminal capable of using their built-in disks to LOAD and SAVE EuroBEEB programs.

Development Pack for BBC Model B, or Master, or Stand-Alone EuroBEEB with 3 1/2" disk	CK669DC	£95.00 §
Development Pack for BBC Model B or Master with 5 1/4" disk	CK668DC	£95.00 §
Development Pack for IBM PC/XT or AT or compatible with 5 1/4" disk	CK860AA	£95.00 §
EuroBEEB Operating System Manual (MOSB4)	CB664AB	£25.00
EuroBEEB Advanced O/S Manual (MOSB4)	CB665AA	£25.00
AutoMOSB4 Manual	CB668TA	£10.00
AutoMOS4C Manual	CB663TA	£10.00

§ Development Packs are only £55, when purchased with the combination of any standard rack and the standard EuroBEEB. Please quote "Development System" when ordering at £55. Existing customers can upgrade to AutoMOS4C free of charge. Ask for details.

Control Forth
Multitasking Control Language for EuroBEEB
Features:
To Forth-83 standard
Up to 28 simultaneous tasks
Full screen editor and 6502 assembler
Supports BBC-compatible OS calls and random files
Supports interrupt handling
Generates ROM-able code for target applications
Supports CUBE range of i/o
Large dictionary of Forth words extendable by the user

Control Forth is supplied as a ROM and Manual, plus a 3 1/2" disk with a Forth dictionary extension. The ROM requires one of the sideways memory sockets available on CU-MEM Selecta, CUBE Doublestore or the CUBE IEEE Interface, or else can replace BBC BASIC in the EuroBEEB.

Control Forth for EuroBEEB	CP659BF	£75.00

Real Time BASIC IV for EuroBEEB and BBC Master
**Multitasking Real Time
Control Language**

Real Time BASIC makes the following tasks easy:-
 TURNON and TURNOFF output CHannels
 Respond WHEN an input CHannel changes state
 Respond to end-of-conversion of an analogue input signal
   (WHEN ADVAL)
 Control the elapsed TIME of events
 Control events with respect to real time CLOCK
 Respond with a defined action WHEN an operating system
   event occurs (eg. input buffer becoming full)
*The capital letters refer to the actual commands available in an ordinary
BASIC statement to achieve these control tasks.*

Real Time BASIC Facilities:-

16 Process Timers	Keystrokes (keyboard event)
32 Digital Input Lines	128 Analogue Inputs
Real Time Clock	BASIC User Event
Control NET Event	

Controlling Multiple Real Time Tasks
Real Time BASIC provides ways to:-

Define discrete tasks	Make a task active
Put a task to sleep	Discard a task
Run a main line routine while tasks execute	

Responding Quickly
If there are any active WHEN statements, the machine code kernel of
Real Time BASIC checks all of the above events for a change of state
100 times a second. Because RTB is designed for a real (ie noisy) world,
spurious signals are discriminated against by checking that a change of
state lasts for two consecutive checking cycles. Thus none of the above
events will be missed if they last for more than 1/50th second.

Free Multiple Licence
Real Time BASIC for EuroBEEB comes with permission for the purchaser
to make copies of RTB for use with further EuroBEEBs. For the BBC
Master each copy of RTB must be purchased separately.

The fully populated EuroBEEB fitted with BASIC IV requires RTB IV. A
manual is supplied. RTB IV for the EuroBEEB and BBC Master is supplied
as object code files on the same disk ready to be 'blown' into EPROM.
On the BBC Master, a sideways memory socket is required; use on
EuroBEEB requires two sideways sockets available on a CU–MEM
Selecta, CUBE Doublestore or the CUBE IEEE Interface.

RTB IV for EuroBEEB/BBC Master (3 1/2" disk)	CP656RB	£75.00
RTB IV for EuroBEEB/BBC Master (5 1/4" disk)	CP655RB	£75.00

Control Net
Robust Industrial Network at Very Low Cost

Control Net allows a EuroBEEB or a BBC Master or Model B to act as the
supervisor of a network of up to 256 EuroBEEBs.

Messages are "framed" or packeted, and transmitted through RS423
(3–wire, up to 600m) or RS422 (5-wire, up to 1200m), at up to 9600 baud.
Block Check Sum techniques reveal bad transmissions, and the sending
station will automatically re-try if it fails to get a "message OK" signal.

Control Net is only sold integrated with Real Time BASIC, as the ease of
use afforded by RTB is the vital ingredient that makes it such an
attractive proposition to the application engineer.

Free Multiple Licence
By way of an effective bulk discount for EuroBEEB users only, the
EuroBEEB version of Control Net comes with permission for the
purchaser to make copies of it for use with further EuroBEEBs that are
bought. For the BBC Master, or Model B, each copy required must be
purchased separately.

Control Net (with Real Time BASIC) for EuroBEEB, BBC Micro and theBBC Master, 3 1/2" disk	CP667CC	£95.00
Control Net (with Real Time BASIC) for EuroBEEB, BBC Micro and theBBC Master, 5 1/4" disk	CP667CE	£95.00

Sidemon - Machine Code Monitor for EuroBEEB

An invaluable aid to de-bugging programs, particularly those written in
machine code, Sidemon includes:-

 machine code disassembler
 memory examine and change with ASCII character display
 select and examine sideways memory areas
 find EPROM checksums. i.e. using the Cyclic Redundancy Check
   command, *CRC
 fill memory with specified byte
 set break points
 set pointer and go

Sidemon is supplied as a ROM and Manual. The ROM requires a
sideways memory socket which are available on CU-MEM Selecta, CUBE
Doublestore or the CUBE IEEE Interface.

Sidemon Monitor for EuroBEEB	CP654AY	£35.00

BEEBEX
The Power of CUBE
on the BBC

Allows CUBE peripherals to extend the i/o and memory capabilities of
   the BBC Micro and Master through its 1 MHz bus connection.
Real Time BASIC, in conjunction with the new PD ("Peripheral Drivers")
   ROM makes application easy and efficient.
64kB independent memory area for expansion to BBC
Does not interfere with any function of the BBC itself
Replaces the CPU card in any sized rack

The following CUBE units are suitable for use with BEEBEX:

CUBIO	INDIO	
READ-24	POWER-50	} Digital i/o
Watchdog	Prototyping Card	
CUBAN-8	CUBAN-12A	} Analogue i/o
CUBAN-12B		
CU-MEM	CU-MEM Selecta	Memory

BEEBEX offers organisations with BBC Masters or Model B Micros the
means of extending the computer in an economical and professional way.
This concept is particularly popular in laboratories where the 19" rack
presentation of the entire system is not needed, but where the
input/ouput capabilities of the BBC are inadequate.

Digital i/o from TTL level to mains voltage at up to 3 Amps; 8–bit, fast
12–bit and high accuracy 13–bit analogue interfaces and both linear and
paged memory extensions are all catered for by this system. In addition,
the Watchdog can monitor continued system healthy state and cause an
interrupt or a reset in the event of an error. The Prototyping card provides
a means of building an experimental circuit connected to the built-in VIA
port on the card, where the control of the VIA i/o lines is also provided
under Real Time BASIC.

BEEBEX can be used without Real Time BASIC or the PD ROM, but the
advantages of Real Time BASIC make it a very attractive proposition for
Control and Monitoring Purposes. The PD ROM provides the Peripheral
Drivers to enable Real Time BASIC to drive the CUBE i/o through BASIC.
It is not useful on its own without Real Time BASIC.

BEEBEX can be used in any sized rack fitted with a CUBE BUS
backplane, but for reasons of economy the 4-slot minirack is the most
popular. Supplied complete with 500mm interconnection cable. See page
8 for details of racks.

BEEBEX Extender for BBC Micro or Master 1 MHz bus	CE270AR	£85.00
Real Time BASIC for BBC Master	CP652BM	£75.00
PD ROM Peripheral Drivers Software	CP653PD	£45.00
4-slot Minirack	CR004DD	£164.00
NB. Minirack code CR004DD was CR001DD. Specification is unchanged.		

EuroCUBE-09 - the ideal target card

The 6809 is popular with programmers because it has many features that make it more powerful than the 65C02. It is supported by a wide range of development tools under the Flex operating system which improve the productivity of the software engineer while still aiming at a low-cost target card, the EuroCUBE-09, which is complete with ready-to-use operating system. This card has the further advantage that it is supported by the entire range of CUBE peripheral cards, plus a library of peripheral driver software routines, leaving the engineer only with the task of writing his application-specific code.
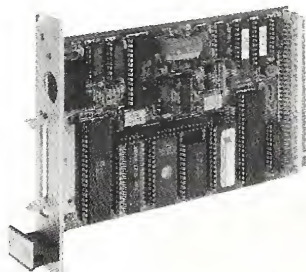
EuroCUBE-09

2kB RAM plus space for two 8kB RAMs or two 16kB EPROMs
MOS provides code download and debugging facilities *
Link-selectable 1 or 2 MHz operation (8 MHz crystal)
On-board real-time calendar clock *
Battery back-up for real time clock and CMOS RAM *
Buffered RS422/RS423 serial port *
16 digital i/o lines plus 4 control lines
On-board timer
Complete with front panel and LED power indication *

Code for the 6809 is normally written in compilers such as "C" and PL/9 which have several advantages for the proficient programmer, com-pared with interpreter languages such as BBC BASIC on the EuroBEEB:-
A socket is freed on the CPU card
16kB of linear memory is freed
There is no cost associated with the use of a copyright product
   such as BBC BASIC
Compiled code runs much faster than BASIC

Developing EuroCUBE-09 Applications

See under "Configuring Rack Systems" (page 8) and "6809 Packaged Systems" (page 10) for 6809 development.

EuroCUBE-09 computer board	CE092CF	£239.00
EuroCUBE-09 without RAM or MOS	CE092CU	£215.00
Economy version - without starred (*) items in features list above	CE095CU	£127.00
Additional 8kB RAM chip, type (5565)	CP008RA	£6.00

£69.85!

The special price of the Economy version of EuroCUBE-09 in 100+ quantities is £69.85 for a full-size Eurocard unit with bus interface capable of driving a full rack of other cards

Software for 6809

"C" Compiler

The "C" language is becoming the world standard for development languages, and has been implemented on most processors capable of supporting a compiler. "C" suffers very little from incompatible dialects, and thus lends itself at source code level to transportation from one computer to another. Choosing "C" therefore builds an upgrade path into the application software development.

McCosh "C" Compiler for 6809/Flex (3 1/2" disk)	FL020MC	£198.00

PL/9 Compiler

This is a very popular development language with our customers as it combines the high level structures of modern compilers with low cost and great simplicity of use. Also available is a library of pre-written routines for handling peripherals, which can be modified or added to by the user. CUBE 6809 development systems include a library of routines for CUBE peripheral cards provided in both machine code and PL/9 source code.

PL/9 Compiler for FLEX (3 1/2" disk)	FL020PL	£148.00
PL/9 I/O Peripheral Drivers Library (3 1/2" disk)	CP090PD	£35.00
PL/9 CU-GRAPH & IEEE PD Library (3 1/2" disk)	CP091PD	£35.00

CU-MEM
Universal
Memory Carrier
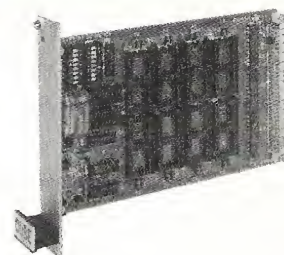
Linear memory card, will carry whole 64kB map
Carries eight byte-wide memory devices in two independent banks
Complete with auto-charging battery back-up circuit for CMOS RAMs
Takes 2764, 27128 EPROMs, or 5565 CMOS RAMs
Two independent banks each have eight switchable start address
   options and allow de-selection of memory in 8kB bands
Complete with front panel

CU-MEM provides extension linear memory to either EuroBEEB or EuroCUBE-09. Use of the two independent banks allow either all RAMs, (achieving a total of 64kB of battery-backed RAM) or a mixture of RAM and EPROM - which could be configured as up to 64kB EPROM plus up to 32kB RAM, although the total cannot exceed the 64kB memory map of either EuroBEEB or EuroCUBE-09. The ability to de-select memory is important as it allows space for input/output channels to be mapped into the system. (For memory chips, see page 7.)

CU-MEM Universal Memory Carrier with no memory devices	CE052UU	£128.00

CU-MEM Selecta
Paged Memory Carrier
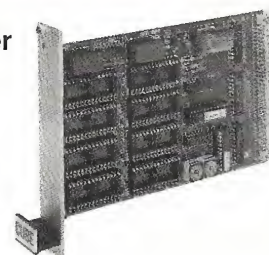
Eight byte-wide memory sockets; each can take up to 32kB EPROMs
   arranged as 16kB paged areas giving 256kB EPROM board capacity
Or, pairs of sockets act as 16kB RAM areas, total 64kB RAM on board
Choice of paged memory area, $8000-$BFFF or $4000-$7FFF
Accepts 2764, 27128, 27256 EPROMs or 5565 CMOS RAMs
Auto-charging battery back-up for CMOS RAMs
Multiple cards allow up to 64 paged areas - equivalent to 1 Mbyte
Linear Memory Option
Complete with front panel

CU-MEM Selecta greatly extends the capability of both EuroBEEB and EuroCUBE-09 by effectively allowing a dramatic increase in the size of the memory map.

EuroBEEB, being BBC Micro compatible, employs a similar technique to that used in the BBC Micro, in that the standard sideways area is $8000 - $BFFF, where BBC BASIC resides. While the BBC Micro environment provides 16 sideways locations, EuroBEEB provides 64. CU-MEM Selecta is most commonly used with EuroBEEB to provide room for EuroBEEB sideways software such as Control Net, Real Time BASIC and Sidemon. In addition, the space can be used for storing data in RAM or EPROM, or BASIC programs can be stored for downloading into linear memory where they can be executed. The RAM data storage application is particularly useful for mass high speed collection of analogue data. The software utility SAMPLE is provided in the EuroBEEB development system, and described under the entry for CUBAN-12B. The low-memory option provides the sideways areas at $4000 - $7FFF, where BASIC programs are capable of being executed directly. CU-MEM Selecta is supplied without any memory devices. (For memory chips, see page 7.)

For EuroCUBE-09, CU-MEM Selecta provides the Silicon disk facility, where all the functions of a Flex-based disk system are provided. Using RAM or ROM, this can be either an addition or alternative to floppy disk. The benefit being much higher speeds, typically ten times faster, and up to thirty times in some tasks. (See in the CUBE disk systems section.) Up to a megabyte of memory can be employed in this fashion, with each Selecta carrying either 64kB of battery-backed RAM or 256kB of EPROM.

CU-MEM Selecta ($8000-$BFFF area)	CE053UU	£158.00
CU-MEM Selecta ($4000-$7FFF area)	CE054UU	£158.00

Memory Chips

CMOS RAM 8kB, type 5565	CP008RA	£6.00
EPROM, 16kB, type 27128	CP016EP	£6.00
EPROM, 8kB, type 2764	CP008EP	£4.00

CUBE Doublestore Disk Controller Card
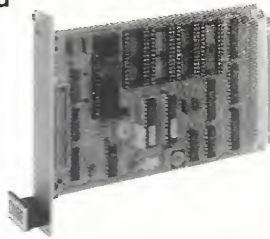
Single density , and with 2 MHz CPU, double density
Four 28-pin paged memory sockets for RAM or EPROM
Supports disk drives on EuroBEEB and EuroCUBE-09
Supports 3 1/2" and 5 1/4" drives
Supports four drives with EuroCUBE-09, two with EuroBEEB
Complete with front panel

Doublestore is the general purpose CUBE disk controller for both 6809 and 6502 (EuroCUBE-09 and EuroBEEB).

In the case of EuroBEEB, it runs a double-density disk filing system (DDFS) compatible, at single density, with the BBC Microcomputer disk filing system (DFS). The BBC Model B , BBC B PLUS and the Master can read and write in DFS, but note that DDFS does not read disks written in the Master's alternative disk filing system, ADFS.

For use with EuroCUBE-09, the Flex operating system is used.

The paged memory sockets on board Doublestore can take four EPROMs of up to 16kB each, or two such EPROMs plus a pair of 8kB RAMs configured as a 16kB memory area. These RAMs are not battery-backed. When used with EuroBEEB, the BASIC ROM chip is removed from the EuroBEEB board and transferred to one of the Doublestore sockets. Another of the sockets is used for the DDFS ROM. The other two sockets can be configured as 16kB of linear memory giving the combination of EuroBEEB and Doublestore a total linear RAM area of 32kB.

CUBE Doublestore, for rack-mounted drive	CE200UR	£235.00
DDFS Disk Filing System ROM for EuroBEEB	CP201BL	£50.00
Flex Operating System on 3 1/2" diskette	FL901BH	£75.00

3 1/2" Rack Mounting Disk Module
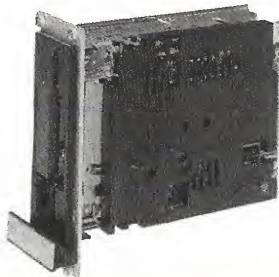
The rack mounting disk module includes one 3 1/2" 80 track double sided double density drive. With both EuroBEEB and EuroCUBE-09, its maximum formatted capacity is 720kB. It occupies two rack slots. The CUBE 16–slot rack is ready wired for powering two disk modules; a data cable is also required - see below.

|		
CUBE Rack Mounting 3 1/2" Disk Module	CD382SR	£185.00

Disk Data Cable

The use of one or two disk drives in the CUBE 16-slot rack requires each drive to be connected to the power supply and to the floppy disk controller. All CUBE racks, except the Minirack, are supplied ready wired for the power supply to 2 drives; a disk data cable is required to make the data connection. The cable below is suitable for one or two 3 1/2" drives.

CUBE disk data cable	CC203AB	£30.00

Diskettes

Box of ten 3 1/2" 80 track double sided double density diskettes	ME382DA	£70.00

CUBE TELETEXT Colour Video Interface
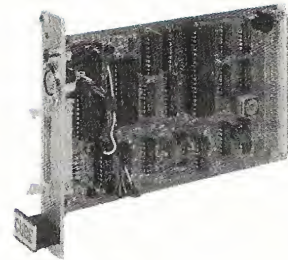
Displays text of 40 columns x 25 rows
Eight colours as RGB or greyscale composite output
Compatible with BBC Mode 7 when used with EuroBEEB
"Chunky" graphics (80 x 75 pixels), flash, double height, etc
"Centronics" parallel printer port
Hardware scroll
Sound output channel to ceramic bleeper
With EuroBEEB equivalent to Mode 7 on BBC Micro
RGB and Composite Video outputs
Supplied complete with front panel, colour and mono cables
Driver software provided for EuroBEEB and EuroCUBE-09

CUBE Teletext Video Interface	CE400BA	£168.00

Genlock Option for CUBE Teletext

The Genlock PCB is a piggyback fitment connected to the CUBE Teletext card. It is designed to allow the text and graphics output from Teletext to be synchronised with another video signal (eg. a picture) and thus successfully mixed on a video screen. The Genlock facility is not supplied separately, and is only available as a factory-fitted option to CUBE Teletext. The combination still occupies only one rack slot.

Teletext Card with Genlock option	CE401GL	£395.00

CU-GRAPH High Resolution Colour Graphics Interface
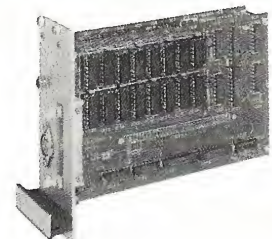
Eight colours with 512 x 256 pixel resolution
85 columns x 32 rows text maximum
Independently programmable character width and height
Italic and vertical characters
64kB of screen memory independent of processor memory
Monochrome or full colour versions
Supplied with both RGB and composite sockets
Complete with front panel, and video cables
Colour version has Centronics Printer Interface
Driver software provided for EuroBEEB and EuroCUBE-09
Operates with 1 MHz CPUs only

When used with EuroBEEB, a wide range of BBC BASIC graphics commands are supported and a pseudo matrix of 1024 x 1024 pixels is realised in an actual resolution of 512 x 256 pixels. This has the effect of providing an equivalent to BBC Mode 0, but in full eight colour mode.

CU-GRAPH monochrome version	CE100AA	£265.00
CU-GRAPH colour version	CE111AA	£365.00

CU-PRINT Low-cost "Centronics" Printer Interface

Printer Ports are fitted as standard to both CU-GRAPH Colour and to CUBE Teletext Video Interfaces. However, should a printer port be required when neither of these units is fitted, CU-PRINT provides an economical solution. Driver software is provided for EuroBEEB and EuroCUBE-09. Supplied complete with front panel.

CU-PRINT Centronics Printer Interface rack-mounted for independent use	CE070AR	£70.00
CU-PRINT Centronics Printer Interface piggyback-mounted onto CU-GRAPH mono	CE070AP	£60.00
Centronics Printer Cable	CC000PC	£22.00

CUBE rack systems are designed to provide an enormous range of possibilities, to suit most applications. These pages are published as a step-by-step guide to a correctly specified rack system.

## 1. Will a Packaged System fit the Need?

There are a number of standard packaged systems offered for both EuroBEEB and EuroCUBE-09. These are all offered at a price less than the combined price of the constituent parts. Packaged Systems are described on pages 10 - 11.

2. Select Your Rack

If a standard system does not satisfy the requirement, you should next choose your rack from the following.

Four Slot "Minirack" †

Low cost
Four CUBE bus slots
Robust steel construction
Built-in power supply:
  +5V @ 3A, -5V @ 0.2A,
  ±15V @ 0.5A
139 H x 129 W x 327 D (mm)
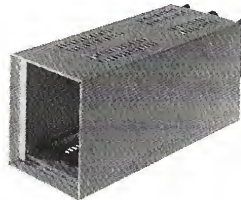
The four slot "Minirack" is especially popular for target applications, being enclosed and ready to use, small in size and low in cost. NB. The Minirack code was CR001DD and has changed to CR004DD without change in specification.

4-slot Minirack	CR004DD	£164.00

Eight Slot "Midirack" †

Low cost
Eight CUBE bus slots
Standard Vero KM6 Caseframe
Built-in 65W switch mode
power supply:
  ±15V @ 0.75A, +5V @ 6A,
 -5V @ 0.2A, +12V @ 1A
148 H x 250 W x 440 D (mm)

8-slot Midirack	CR001HH	£289.00

† The two economical stand-alone racks, Minirack and Midirack, are available <u>only</u> in the two versions shown above. Both are powered from 240V AC, or the user may alter them to be powered from 110V AC.

Sixteen-slot Sub-racks

65W switch mode
power supply:
  ±15V @ 0.75A,
  +5V @ 6A,
  -5V @ 0.2A,
  +12V @ 1A
131 H x 481 W (inc.
  mounting ears) x 394 D (mm)
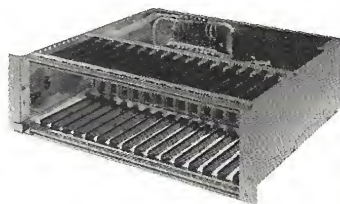
A wide choice of versions is offered to allow configuration of exactly the right rack for your purpose. Your sub-rack configuration can be built-up from the matrix given in the next column.

Start with the basic sub-rack unit with power supply and wiring. Next add the number of 3 1/2" drives, noting that you will also need a Doublestore to drive them, as well as a DDFS for a EuroBEEB System. The appropriate power and data cables will be supplied when disk drives are specified, as will a power and data disk connection to the rear of the sub-rack, allowing a BBC-type external disk pack (either 3 1/2" or 5 1/4") to be connected. EuroCUBE-09 allows up to four drives under Flex, so allowing 1 or 2 external drives of either size to be used with 1 or 2 drives in the sub-rack. EuroBEEB permits only 2 drives, (up to 4 surfaces on 2 drives), so if there is only one drive in the sub-rack, another, of either type, can be connected externally. The drives supplied in sub-racks are 80 track, double sided, double density.

Next, if required, add a 5" monitor (see page 12). Note that CU-GRAPH or Teletext is required to drive it.

Finally add the backplane of the correct length. (Backplanes, see page 12.) Starting with a length of 16, for each disk drive deduct 2, and for a 5" monitor deduct 6, or if supplied with built-in keys, deduct 7. Then select the next lowest standard sized backplane.

Basic sub-rack				£245.00
Number of 3 1/2" disk drives	0	code 0		£0.00
	1	" 1		£185.00
	2	" 2		£360.00
5" Monitor - none required -		code 7		£0.00
- without keys		" 8		£250.00
- with built-in keys		" 9		£300.00
Backplane	16 slot	code P		£133.00
	14 slot	" N		£119.00
	12 slot	" L		£106.00
	10 slot	" J		£93.00
	8 slot	" H		£80.00
	6 slot	" F		£67.00
	4 slot	" D		£53.00

| R | A | | 3 | P | | £ | |

A new part number will be created here where the RA prefix replaces the CR prefix. In line with the company's stricter rules on compatibility, the RA version is identical to the previous CR version. In the event of a non–compatible change in any of the constituent parts of the sub-rack, the RA prefix will become RB. This ensures that any time you quote a part number, identical goods to those previously supplied against that part number can be ordered.

Diplomat Case

The Diplomat case is strongly constructed from aluminium castings and steel panels and finished in two tone grey. Total depth is 422mm, width 530mm, height 162mm not including feet. Takes one sub-rack as above.

Diplomat Case	CR008PU	£75.00

3. Configure the Disk System

Rack

cpu *Doublestore* *Disk Modules*

Disk Data Cable
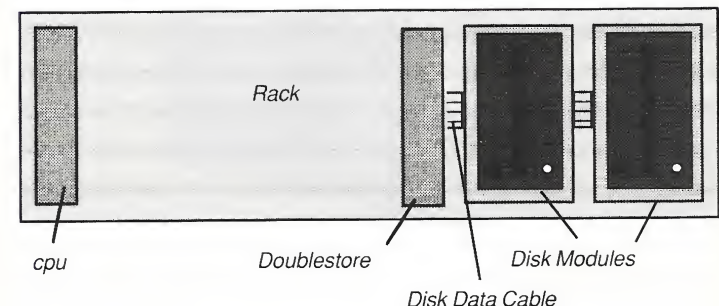
3a. EuroCUBE-09

You will need at least:-

EuroCUBE-09	Two 8kB RAM chips	Doublestore
Flex Operating System	Disk Drive	Rack

EuroCUBE-09 is supplied with a 2kB monitor RAM and the MOS in an 8kB EPROM. One or two 8kB RAM chips can be fitted on-board providing user RAM up to a total of 16kB RAM.

The FLEX operating system requires 8kB RAM and this is recommended to be fitted to Doublestore. Doublestore also provides sockets for two 16kB EPROMs for use in the built-in Silicon Disk filing system.

A CU-MEM Selecta may be fitted which provides sockets for a further 32kB of linear RAM, making 48kB of user RAM altogether. Selecta has four more sockets which can be used as 32kB of Silicon Disk RAM or 64kB of Silicon Disk EPROM.

Each further Selecta offers more Silicon Disk space, as described below.

6809 Silicon Disk Addition

If speed of disk access is important, as would certainly be the case if the Flex system is being used for development, the CUBE Silicon Disk System will be of great assistance. Dependent on the nature of the task, disk access can be up to thirty times faster with silicon disk compared to floppy disk. A speed improvement of tenfold is typical. There is no charge for Silicon Disk as such - everything necessary is already included, bar the extra memory in which to run it. This is provided by the CU-MEM Selecta card, which has eight sockets. These can be configured for 16kB or 32kB EPROMs, for read-only access, or 8kB RAMs for read/write purposes. The permutations on each card can thus be 32kB of RAM, or 128kB of EPROM, or 16kB RAM plus 64kB EPROM. Up to a megabyte of Silicon Disk memory can be accommodated, limited only by the availability of slots in the rack.

3b. 6809 Silicon Disk System without Floppy - cheaper and faster, and solid state

Silicon Disk uses the paged memory technique to provide EPROM and RAM equivalent of floppy disk. The system without floppy is thoroughly practical for a target application, giving the advantages of high speed, economy, and the inherent robustness of solid state systems (especially relevant in mobile situations). Transfers of data in and out are best done with the serial link.

The minimum system consists of:
EuroCUBE-09 with its 2kB monitor RAM, 8kB system EPROM,
   8kB RAM on EuroCUBE-09 to hold Flex, and 8kB user RAM.
Selecta with at least one EPROM with the EPROM version of Flex
Rack (can be a Minirack)

On the first Selecta there are three more sockets which can be used for further paged EPROM areas of 16kB each, plus four more sockets that can hold 32kB linear RAM, two 16kB paged RAM areas or four more 16kB paged EPROM areas. Further Selectas can provide more Silicon disk space as shown above. NB. To configure Silicon disk system without floppy, a system with floppy is required. You will also need an EPROM programmer to configure the files required. (CUPROM JJ. see page 16.)

3c. EuroBEEB Disk System

You will need at least:

EuroBEEB   Doublestore   DDFS ROM   Disk Drive   Rack

DDFS (Double-density Disk Filing System) ROM operates at double or single density; single density is compatible with DFS files on BBC Micro Model B or Master. BBC BASIC and DDFS are fitted to Doublestore, leaving space on EuroBEEB for either Real Time BASIC or 16kB of linear RAM or two sideways EPROM areas of 16kB each.

3d. BEEBEX

BEEBEX does not support disks except on the BBC Master driving it. However, the CUBE rack mounting disk modules are entirely suitable for use with the BBC. Simply specify the rack of your choice with the disk units required. BEEBEX is supplied complete with a 500mm interconnection cable.

4. Add the System Software

4a. EuroCUBE-09 System

Development Pack. If you are going to use the system for development, you will need the development pack which contains the range of development utilities as supplied on CUBEFLEX JJJ (see p.10).

EuroCUBE-09 System Development Pack	CK097AA	£95.00 §

§ The pack is priced at £95, but most users order at £45 if bought with a configured system including at least a standard CPU card and a standard rack.

PL/9 Compiler. This compiler has the advantage of being easy to learn, and efficient in use, particularly as, for the smaller jobs, the editing, testing and compiling are all co-resident in memory, making for much faster compilation and switching between tasks. This same speed advantage can be regained for the larger jobs by fitting a silicon disk of sufficient size. (See above).

"C" Compiler. "C" is a worldwide standard and is transportable between different computers, even those with different processors and operating systems. It will produce compact and optimised code, but requires a little more investment in learning and is not so fast in compilation iterations as the optimisation requires multiple passes. Again, a silicon disk of sufficient size will greatly speed the operation.

4b. EuroBEEB

Development Pack. If you are going to use the system for development, you will need the development pack which contains a range of development utilities and the AutoMOS Program (AutoMOS4C) which configures the operating system with the necessary peripheral drivers for the i/o selected (see page 4). This is priced at £95, but most users pay only £55, the price when ordered as part of a system containing at least a standard rack and a standard cpu.

Languages and Network. See page 5 for details of:

   Real Time BASIC   Control Forth   Control NET

4c. BEEBEX

No development pack is required, but the combination of Real Time BASIC for the BBC Master and the PD (peripheral drivers) ROM makes the system efficient and capable. See page 5.

5. Add the Peripherals Required

5a. Memory (see page 6)

The standard CU-MEM is useful because of its ability to allow deselection in small memory amounts, but for expansion purposes CU-MEM Selecta is better as it allows both linear and sideways operation, mixed if required. Selecta can be used with BEEBEX, EuroBEEB or EuroCUBE-09.

5b. Video and Printer Interfaces (see page 7)

On EuroBEEB, the drivers available by using AutoMOS4C to configure the Operating System make CU-GRAPH and Teletext mutually exclusive. However, the serial link co-exists with either and a serial terminal or the BBC Master can be used in conjunction with either or neither as required.

The Development Pack for EuroCUBE-09 contains drivers for CU-GRAPH, and these drivers are for incorporation into the user's program. A serial terminal can be connected and operated.

CU-GRAPH Colour and Teletext include Centronics printer interfaces; if there is no video, or if CU-GRAPH mono is being used, then CU-PRINT (CE070AP) provides the Centronics printer interface. Of course a serial port can be used instead. Please Note: CU-GRAPH runs only on 1 MHz systems. The current issue of CPUs are 1 MHz / 2 MHz link selectable.

BEEBEX does not support any CUBE Video cards.

5c. Keyboards (see page 11)

Both EuroBEEB and EuroCUBE-09 support the same range of keyboards, using the same interfacing techniques. With EuroBEEB, the driver software is incorporated in the MOS, and the choices are made during the running of the AutoMOS4C program. With EuroCUBE-09, the choice of drivers is available in the Development Pack.

BEEBEX does not support keyboards.

CU-KEY-99 plugs into the parallel port of the CPU. The keyboard interface is incorporated into the keyboard. Note that one eight-bit port remains free, and a connector is provided on CU-KEY-99 in the pin-out of the BBC user port. (The Softlife EPROM programmer can be plugged in here.)

CU-KEY-25 does not come complete with the keyboard interface. The Jobber Interface includes a built-in keyboard interface, so CU-KEY-25 can be plugged directly into it. Alternatively, the keyboard can be plugged into the CPU parallel port via the keyboard interface.

An "ASCII and strobe" keyboard from another source can be used - the system caters for keyboard input in the form of an 8-bit parallel signal plus a strobe line. It is up to the user to configure the connection from the keyboard into the pinout of the CUBE digital port on the CPU.

CUBE cpu cards can also accept input from serial keyboards. The current issue of CPUs include a 5V and ground connection to power the keyboard from the CPU serial port.

5d. Rack Mounting Units (see page 11)

The rack mounting units, Rackprint, Viewline and CU-KEY-25 are supported by both EuroBEEB and EuroCUBE-09 but not BEEBEX. All three are interfaced by the Jobber Interface. When using these units, we recommend considering the pre-packaged Jobber systems (see page 11) which has the useful "back-to-front" arrangement allowing free access to the Eurocards without disturbing the display units. The rack-mounting 5" monitor (page 12) is driven equally well by CU-GRAPH or Teletext.

5e. Communications (see page 16)

With SERIO, EuroBEEB supports four further serial ports in addition to the one on the cpu, all being fully buffered and interrupt driven and integrated into Real Time BASIC. More can be fitted, but it is then up to the user to provide software drivers.

EuroCUBE-09 peripheral drivers permit as many serial ports to be fitted as the user requires. The IEEE Card requires the Procyon IEEE Filing System when used with EuroBEEB; drivers for EuroCUBE-09 are supplied with the card. Software is not available to allow BEEBEX to support either serial ports or IEEE.

5f. Digital i/o (see page 15)

On EuroBEEB, Control BASIC and Real Time BASIC fully support all CUBE digital i/o. In a similar way, Real Time BASIC on the BBC Master, in conjunction with the PD ROM, supports all CUBE digital i/o plugged into a rack with BEEBEX. EuroCUBE-09 peripheral drivers support all CUBE digital i/o.

5g. Analogue i/o (see page 13)

All CUBE analogue i/o is supported by EuroBEEB, BEEBEX and EuroCUBE-09 just as for digital i/o. Note that CUBAN-8 runs only in 1MHz systems. The current issue of CPUs are 1 MHz / 2 MHz link selectable.

5h. Signal Conditioning (see page 13)

The signal conditioning cards require no software support. They can be used with EuroBEEB, BEEBEX or EuroCUBE-09. Note however that AMP–I/O is designed for CUBAN-12B only, and that CUBAN-8 is not supported by signal conditioning cards.

6. Add Configuration Charge

There is no configuration charge for packaged systems, nor for systems upon which no discount is being given. Only when discounts are given need the configuration charge be added, at the rate of £10.00 per rack, plus £5.00 for each card. These charges are discounted at the same rate as the rest of the Eurocards.
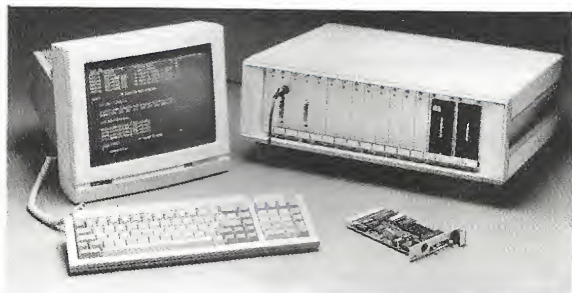
7. Discounts

Please contact our Sales Manager, or one of our Regional Sales Engineers, for more information on our discount structure.

6809 Packaged Systems   CUBE

CUBEFLEX III

Features:

Stand-alone 6809 development system
2 MHz (switchable to 1 MHz) EuroCUBE-09 with battery-backed Real Time Calendar Clock
225kB memory including 122kB non-volatile CMOS RAM
Memory expandable to 1 MB total
Silicon Disk System for FAST program compilation
Complete with FLEX operating system including 6809 macro assembler and TSC line editor
Resident debugging machine code monitor
SP-EDIT powerful screen editor incorporated in ROM Disk
Ferret disk editor/recovery utility
Flex extended utilities + CUBE utilities
Software drivers for CUBE peripheral cards
Twin 3 1/2" disk drives of 720kB capacity each
19" subrack with 7 spare slots enclosed in Diplomat case
External connections for 5 1/4" drives -code CD582TF (See page 20)
Auto-select 40/80 track, single/double density

CUBEFLEX III combines all the best features of the capabilities of a CUBE 6809 system. This system is designed for serious development work using compilers where the efficiency of silicon disk really counts. The recommended human interface is a Wyse-30 serial terminal which provides an ergonomic and cost-effective display and keyboard.

CUBEFLEX III development system	CR093BC	£1975.00
Wyse-30 Serial Terminal	TS030WY	£445.00
Flex Advanced User's Guide Book	FL110AG	£18.00
Serial Cable - CUBE to Terminal	CC650DD	£25.00

BEEBFLEX - 6809 Development with the BBC

Features:

2 MHz 6809 second processor adds the power of Flex to the BBC Microcomputer - Model B or Master (connects via TUBE)
Can drive a standard serial terminal during and after development
Operates as a stand-alone system after development
58kB of battery-backed RAM
Supplied in a 4-slot rack with power supply and 2 expansion slots
All CUBE bus peripheral cards are suitable for expanding this system, except CU-GRAPH and CUBAN-8
Driver software is included for CUBE peripheral cards
With software for 1 MB Silicon Disk System - see page 9
Flex operating system supplied, which includes disk filing system, line editor, machine code assembler and library of utilities
Flex runs a wide range of languages, including compilers such as "C"
BBC remains fully usable in normal non-Flex mode
Will run standard BBC disk system - VIEW can be used for source code
Extensive 6809 machine code monitor

BEEBFLEX allows highly productive development languages such as "C" or PL/9 to be used to generate efficient and compact code. All of the CUBE bus range of peripheral cards are suitable for use with EuroCUBE–09 and fit in the two spare slots in the minirack. Thus the development system can become an economical target system when development is completed.

The BBC remains entirely standard and fully usable in its standard mode. The presence of the Flex operating system and the special sideways ROM supplied, allow the standard disks of the BBC to operate both normally and in the international Flex standard format.

| BEEBFLEX 6809 System for use with BBC | CR098EA | £695.00 |

Jobber Systems
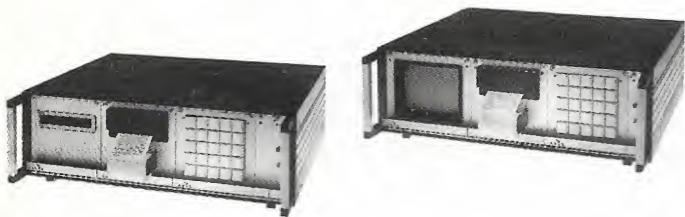
There is a choice of two types of Jobber, with either LCD or CRT displays, both with built-in 25-way keyboard and 24 column printer. Unique double–sided rack construction with display devices on front and complete 16-slot card frame on rear. The Jobber System comprises:

    EuroBEEB with 16kB RAM, set at 2 MHz; switchable to 1 MHz
    Jobber Interface
    Jobber LCD has16-slot powered caseframe with14 spare slots
    Jobber CRT has 10-slot powered caseframe with 7 spare slots
    Rackprint - 24 column wide impact printer
    CU-KEY-25
    Viewline liquid crystal display - 24 characters x 2 rows
    Supplied in KM6 caseframe

The Jobber Liquid Crystal System is designed for those Industrial Control and Monitoring situations where the operator needs to be prompted and allowed to enter limited information, but where the full facilities of a QWERTY keyboard and video display are not required. The printer provides a permanent record of results as required, 24 column wide.

Similar to JOBBER LCD, the CRT version provides a 5" monochrome video display in addition to the 25-way keyboard and the 24 column printer. 40 column Teletext script is crisp and easily readable, and can be enlarged with the double height facility. CU-GRAPH allows programmable characters from 85 column size to huge versions that almost fill the screen, and in addition allows full graphical displays. CU-GRAPH operates with 1 MHz CPUs only.

Jobber LCD system in caseframe	CR613PJ	£975.00
Jobber CRT system in caseffame with Teletext	CR620PT	£1295.00
Jobber CRT system in caseframe + CU-GRAPH	CR620PG	£1395.00

Hi-Res Unit

Serial Input

Colour Video Output

The Hi-Res Terminal Interface, a 1 MHz system, provides hi-resolution colour graphics (512 x 256 in three planes of colour) which are accessed by a serial connection from any computer able to provide the necessary BBC Micro VDU commands on an RS423/RS422 port. It consists of a 8kB EuroBEEB in a 4-slot rack with colour CU-GRAPH. No programming is required; the Hi–Res Unit is ready to use.

Hi-Res Unit	CR617DC	£775.00

Analogue Data Capture Unit

Serial Connection to Host Computer

Analogue connection to equipment

Packaged system designed to read 12 bit analogue data at up to 10,000 samples per second on a single channel, or up to 1000 samples per second from each of the eight input channels provided. 96kB of RAM is provided purely for data storage, in addition to the 16kB RAM on the standard EuroBEEB. The unit comprises the EuroBEEB, CUBAN-12B, two CU-MEM Selectas and SAMPLE software, which also provides convenient read-back facilities. The ADCU is supplied at 2 MHz, but is switchable to 1 MHz.

|		
Analogue Data Capture Unit	CR615DB	£1095.00

CU-KEY-99
Robust Industrial
QWERTY Keyboard

99-keys arranged as QWERTY with10 function
    keys plus 25-way hexadecimal keypad
Robust steel case
Plugs into digital port of EuroCUBE-09 or EuroBEEB
8-bit digital user port connector on rear
Scanning circuit detects keystroke and generates interrupt
High reliability Futaba keyswitches
62 H x 480 W x 177 D (mm)

CU-KEY-99 Enclosed Keyboard	CE999EN	£155.00

Rack-Mounting Interface Units
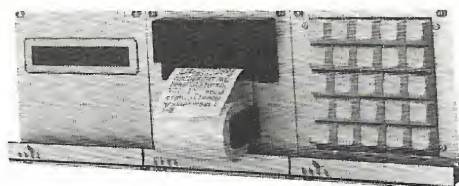
Viewline

Rackprint

CU-KEY-25

All three units are designed to be driven from the Jobber Interface shown on following page. (CU-KEY-25 can be driven from any CUBE digital port.) The three units are designed without rearwards projections, so can be mounted in front of rack-mounting cards, so saving rack slots. However, this arrangement does not allow connections on the cards behind the units to be easily accessed. Hence, an alternative arrangement is to mount the units on the back of the rack, and then treat that as the "front", with the cards then being plugged in the "back". See Jobber Systems above.

CU-KEY-25 Rack-Mounting Keyboard
    Supplied with 25 unmarked white keys suitable for custom engraving
    5" wide - takes up 5 slots in a CUBE rack
    Plugs into Jobber Interface directly, and through an interface
      into the parallel VIA port of either EuroCUBE-09 or EuroBEEB
    Driver software provided for EuroBEEB and EuroCUBE-09

CU-KEY-25 Rack-Mounting Keyboard	CE993FP	£55.00
CU-KEY-25 without front panel	CE993UE	£39.00
CU-KEY-25 Interface (non Rack-Mounting)	CE993I F	£55.00

Viewline Rack-Mounting Liquid Crystal Display
    24 character x 2 row Liquid Crystal Display
    LCD is supplied as standard with illuminated screen
    Driver software provided in EuroBEEB development system
    Plugs into Jobber Interface, which drives the other rack interface units

Viewline Rack-Mounting LCD Unit	CE480FP	£115.00

Rackprint Rack-Mounting 24 Column Printer
    24 column wide impact printing on 2" wide paper at 2 lines/sec
    Graphic dot-addressability at 144 dots full width
    5" wide unit takes five CUBE bus slots
    Driver Software provided in EuroBEEB development system
    Plugs into Jobber Interface, which drives the other rack interface units

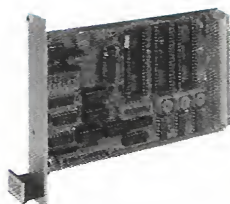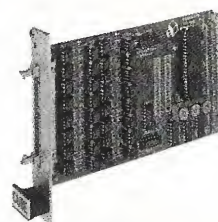|		
Rackprint Unit	CE240FP	£95.00

JOBBER Interface
Rack Display Unit
Driver Card

Drives Rack-Mounting 24 Column x 2 Row Liquid Crystal Display
Drives Rack-Mounting 24 Column Printer
Drives Rack-Mounting 25-way Keypad or Table-Mounting QWERTY
  Keyboard (CU-KEY-99)

Jobber Interface complete	CE490AA	£135.00
Jobber Interface without printer driver chip	CE490AB	£105.00
Jobber interface with CU-KEY-25/99 keyboard interface only	CE490AK	£55.00

5" Rack-Mounting
CRT Monitor

Without Keys

With Keys

High definition green screen 5" CRT monitor
Designed for mounting in 3U high 19" racks - eg. CUBE racks
Without keys Panel is 6" wide - takes up six CUBE rack slots
With keys Panel is 7" wide - takes seven CUBE rack slots
TTL level input - suitable for use with CU-GRAPH or CUBE Teletext
Requires single 12V supply - available on 16-slot CUBE rack
Designed to be compatible with CU-KEY-25 (small rack-mounting
  keypad) and with Rackprint (rack-mounting 24 column printer)
75Ω input inpedance

The rack-mounting monitor is designed for those circumstances when a rack-mounted display is desirable but the 24 column x 2 row LCD shows insufficient information. Text is entirely readable at 40 column width (equivalent to BBC Mode 7), and with CUBE Teletext characters can be made double height for additional readability. The programmable character size on CU-GRAPH allows displays from 85 columns (hard to read on this display) to being able to almost fill the screen with a single character.

The other version (CE005MS) has 14 built-in keys (two groups of 7). It takes less panel width than the combination of the keyless version plus CU-KEY-25, and has the added advantage that interactive displays can point to the keyboard to offer direct choices to the operator instead of using the menu approach. This scheme can be seen in most cash dispensing machines used by banks. The version with keys includes the CU-KEY-25 interface (CE993IF) and is connected to the CPU card's digital port.

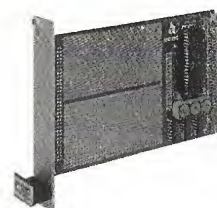|		
5" Rack-Mounting CRT Monitor without keys	CE005MS	£250.00
5" Rack-Mounting CRT Monitor with keys	CE005MK	£300.00

CUBE Opto-isolator

16 opto-isolated bi-directional channels
Sink or source 20mA up to 30V DC

CUBE Opto-isolator is a 16-channel, bi-directional opto-isolated input/output interface which is bus-compatible with the EuroCUBE-09 and EuroBEEB CPU cards. To the processor, the card appears as a single VIA, occupying only 16 bytes of memory which can be placed anywhere in the 64kB address map. The Opto-isolator can be used with other CUBE Delegate cards in any combination. The VIA powers up in input mode so that outputs are initially switched OFF. Supported as a standard digital i/o device by Control BASIC, Real Time BASIC and 6809 Peripheral Drivers.

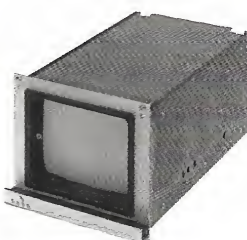|		
CUBE Opto-isolator card	CE910AA	£118.00

CUBE
Prototyping Card

Standard 6522 VIA i/o chip on one third of the card
VIA is fully decoded to 16 bytes in the memory map with three
  rotary hex switches for instant memory location setting
Two thirds of the card is ready-drilled and tracked for prototyping work
VIA has:-
  Port A - 8 i/o lines each with 1 LS load capability in output mode
  As inputs, signals can be latched so permitting counting of
    high speed pulses on a large number of input lines
  Port B - 8 i/o lines each with 4 LS load capability in output mode
  2 control lines for generating interrupts
  2 timers of 16-bit accuracy
Control BASIC and Real Time BASIC support manipulation of i/o lines
  with statements suich as TURNON, FLIP (see EuroBEEB)
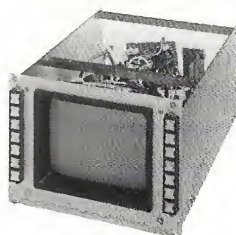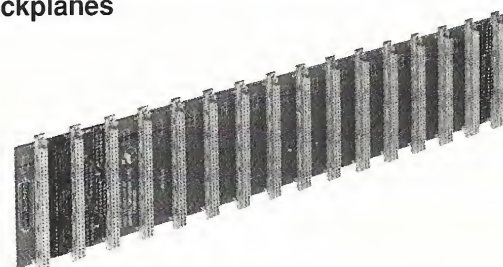Fully suitable for use with either EuroBEEB or EuroCUBE-09
Complete with front panel
Prototyping area accounts for two thirds of the card - ie the prototyping
  area is approximately 100mm x 100mm.

CUBE Prototyping card	CE907AA	£75.00

CUBE Backplanes

Plug-on power supply connections
Very wide power and ground tracks for minimum volt drop
Bus-termination provision at both ends; except 6 and 4-way, one end only
Address bus buffers for additional drive capability
Provision for additional decoupling capacitors

CUBE Backplane 16-way	CE142BP	£133.00
CUBE Backplane 14-way	CE142BN	£119.00
CUBE Backplane 12-way	CE142BL	£106.00
CUBE Backplane 10-way	CE142BJ	£93.00
CUBE Backplane 8-way	CE142BH	£80.00
CUBE Backplane 6-way	CE142BF	£67.00
CUBE Backplane 4-way	CE142UD	£53.00

(The 4-way backplane is without address bus buffers.)
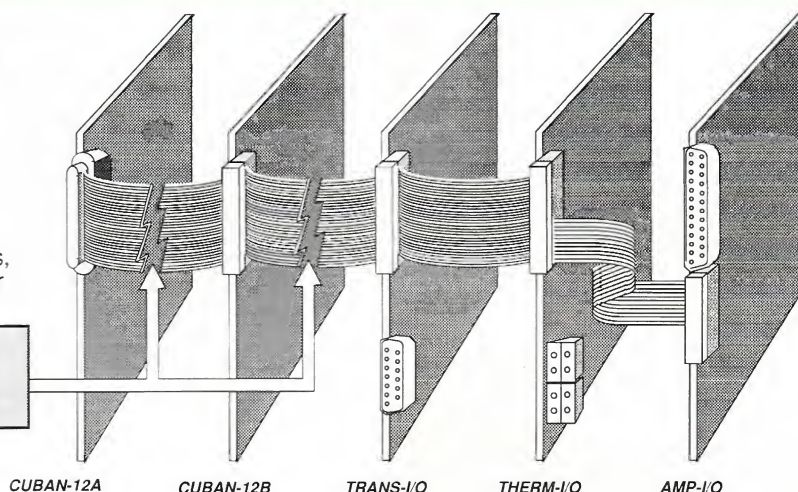
The CUBE
Analogue System

Analogue Connection System

Multiple Analogue Systems possible in one rack with one CPU

Maximum 16 input channels, plus 4 output channels per Analogue System

| 1 or 2 CUBAN-12B Cards |
| OR 1 CUBAN-12A Card |

TRANS-I/O - 8 Channel Transducer Amplifier

THERM-I/O - 4 Channel Thermocouple Interface

AMP-I/O - 4 Channel Output Amplifier (plus passive input interface)

CUBAN-12A   CUBAN-12B   TRANS-I/O   THERM-I/O   AMP-I/O

The CUBE Analogue System is a fully integrated system designed for the best combination of convenience of use, performance and economy.

The choice between the two twelve bit analogue-to-digital converter cards is determined by the relative demands of accuracy in noisy conditions and speed of conversion, which favour the CUBAN-12A and CUBAN-12B respectively. The 12A version is also lower in cost, and has twice the number of channels. The 12B has the option of up to four digital-to-analogue output channels.

Both the CUBAN-12A and the 12B are suitable for use with either EuroBEEB or EuroCUBE-09, and are supported by driver software supplied in Control BASIC/Real Time BASIC and the 6809 peripheral drivers library respectively.

There are three signal conditioning cards whose purpose is to extend the usability of the analogue interfaces. They enjoy a unique connection scheme that allows differing types of signal conditioning card to be mixed in use with the same analogue interface card, as well as allowing multiple cards of the same type.

Some of the conditioning cards have four channels, and some have eight. The CUBAN-12A has sixteen input lines and the CUBAN-12B has eight. Through the connection scheme, signal conditioning cards can use all the available channels on the analogue interfaces, so realising an economical arrangement.
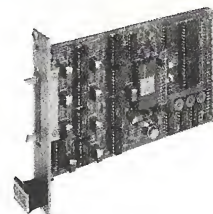
Standard cables provided by Control Universal have either the 25 pin "D" connector for the 12A or the 26-way IDC connector for the 12B.

CUBAN-12A
High Accuracy Low Cost Analogue-to-Digital Converter
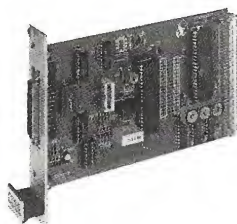
13-bit accuracy including sign bit, plus over-range bit
Resolution $\pm 1/2$ lsb (least significant bit)
12.5 conversions/sec, alterable to 33 conversions/sec
16 single-ended or 8 differential channels, switch-selectable
Can be configured as 8 channels of 4-20mA current loop
Supplied with header for fitting current loop resistors
Unipolar or bipolar operation (ie. -4V to + 4V)
Sensitivity alterable from 1mV/bit to 0.1mV/bit
  (ie. full scale deflection range of 4.094V down to 0.4096V)
Input impedance greater than 1MΩ
Integrating conversion features inherently excellent noise rejection
Input over-voltage protection
Optional -5V converter for single-rail use (CUBE racks have -5V)
Standard 25-way D type connector for ribbon or discrete wires
Start- and end-of-conversion signals brought out to connector
Five digital i/o lines and two 16-bit programmable timers
Software support under Control BASIC and RT BASIC for EuroBEEB
Library modules provide software support for EuroCUBE 6809 use
Complete with front panel

CUBAN-12A is an integrating analogue-to-digital converter, which is a type of conversion technique that inherently offers high noise immunity. Because of this immunity, accuracy of signal reading is high. The conversion speed is supplied set to 80ms which gives the maximum rejection of mains noise. This is equivalent to 12.5 conversions/sec, which can be increased up to 33 conversions/sec. Higher speed requirements than this should be satisfied with the CUBAN–12B.

The card has full address decoding down to 16 bytes, and can be placed anywhere in the memory map that the operating system allows. Control BASIC and Real Time BASIC are organised to cater for 128

channels, whether these are single-ended or differential. If more than this is required, CUBAN-12A is easy to drive directly, and more cards can be added. 6809 users have no limitation on the number of channels – the library software can be extended to cope with any number capable of being fitted in the rack.

| CUBAN-12A Integrating Analogue Interface | CE300AA | £195.00 |

CUBAN-12B
Fast 12-bit
ADC/DAC

Eight 12-bit Analogue input channels single ended
Four D-A outputs
Conversion speed typically 25 μs
CUBE software allows read and store at 10kHz
Accuracy ± 1 lsb
Sample-and-hold amplifier for accurate AC operation
Input range ± 5V to ± 10V or 0 to +10V
Up to four latched 12-bit analogue output channels
DAC amplifiers fully null adjustable
DACs reset to 0V on power-up
Unipolar or bipolar operation
Address decoded to 16 bytes
Full software support for EuroBEEB and EuroCUBE-09
Four digital i/o lines and three handshake lines, + two counter/timers
All signals brought out to 26-way ribbon cable connector at front
Complete with front panel

CUBAN-12B provides high speed conversion for those situations where the speed of the CUBAN-12A is inadequate. A EuroBEEB software utility called SAMPLE provides for up to a megabyte of data to be read in at up to10kHz from a single channel and stored in battery-backed sideways memory. This same software can provide multi-channel recording at up to 1kHz on each channel depending on the number of channels, and can also operate a convert-and-store routine as a background task while operating a mainstream BASIC task without the use of Real Time BASIC.

CUBAN-12B with analogue inputs only	CE120AN	£315.00
CUBAN-12B with analogue inputs + 1 DAC	CE120AA	£344.00
CUBAN-12B with analogue inputs + 2 DAC	CE120AB	£372.00
CUBAN-12B with analogue inputs + 3 DAC	CE120AC	£399.00
CUBAN-12B with analogue inputs + 4 DAC	CE120AD	£425.00
CUBAN-12B, with 4 DACs but no analogue inputs	CE120ND	£274.00

AMP-I/O

Output Amplifier and Input Conditioner for use with CUBAN-12B
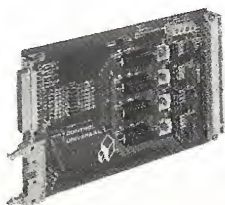
Four output channel amplifiers providing either:
  -voltage-to-current converter/transmitter or
  -unity gain non-inverting power amplifier
Eight channel passive input conditioner, either:
  - voltage divider or - RC filter
High noise-immunity current transmission
25-way D-type connector for ribbon or discrete wiring
Can be powered from backplane or directly to on-board connector

In the voltage-to-curent option, AMP-I/O accepts a signal from any or all of the four CUBAN-12B output channels, and provides a corresponding current signal in the range 4-20mA (see data sheet for other options).

Settling time	: 20 microseconds
Non-linearity	: 0.025% max, 0.01% typ
Span error	: 0.6% max
Offset current	: 0.5% max

AMP-I/O needs a 24V supply - this is provided on the 16-slot CUBE rack.
In the other option, the card provides a unity gain non-inverting power amplifier, with internal thermal overload protection.

Output load	: 320mA max
Output power	: in the order of -10V to +10V into 50Ω
Slew rate	: 0.5V/μSec
Short circuit current	: 200mA max

The passive input signal conditioning circuit is supplied on all options, complete with the 499Ω 0.5% shunt resistors required to achieve conversion from 4-20mA to 0-10V. Variations on this theme can be simply organised by the user.

AMP-I/O with 4-way voltage-to-current converter option and 8-way passive input circuit	CE540DN	£195.00
AMP-I/O with 4-way power amplifier option and 8-way passive input circuit	CE540ND	£195.00
AMP-I/O with 2-way power amplifier , 2-way voltage-to-current option and 8-way passive input circuit	CE540BB	£195.00
AMP-I/O with passive input circuit only	CE540NN	£75.00

TRANS-I/O

Quad Transducer Amplifier for CUBAN-12A and CUBAN-12B
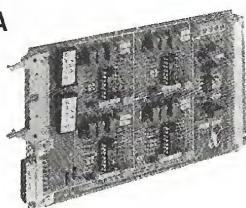
Four differential input circuits with individually selectable and adjustable gains
Suits a wide range of transducers eg:-
  resistance temperature detectors (RTD's, e.g PRT's)
  strain gauges, load cells and other bridges

High common mode noise rejection, filtered normal mode rejection
DC-shifted voltage output, can be controlled by DAC on CUBAN-12B
Precision reference to energise bridges, + precision bridge for RTD's
15-way D type connector for ribbon or discrete wiring

TRANS-I/O provides four channels of general purpose   linear amplification for transducer signals, with gain settable in the range 1 to 500. The circuits are suitable for buffering or amplifying transducer signals which are too small or otherwise unsuitable for inputting directly into a standard analogue-to-digital converter.

The daisy-chain wiring system allows two TRANS-I/O cards to be used with each CUBAN-12B and four with each CUBAN-12A. Note that the use of TRANS-I/O effectively makes all inputs on either of the A-D cards into differential type.

TRANS-I/O pre-set to 0 - 30 mV input	CE550AA	£245.00
TRANS-I/O pre-set to 0 - 100 mV input	CE550AB	£245.00
TRANS-I/O pre-set to customer requirement	CE550AX	£295.00
(Including calibrated PRT option:- Quad PRT Conditioner , OR Dual PRT and Dual Bridge Conditioner)		

THERM-I/O

Quad Thermocouple Amplifier for CUBAN-12A and CUBAN-12B
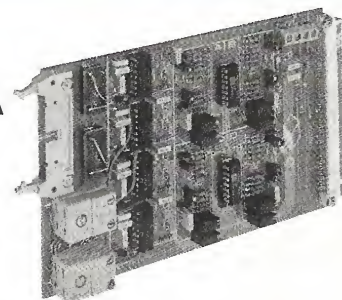
Four individual Thermocouple Amplifiers
Choice of version for type J or type K thermocouples
Cold junction compensation
DC shifted voltage output, preset or DAC controlled
Thermocouple failure detection
Industry-standard thermocouple connectors on-board
Backplane or externally powered

THERM-I/O provides an input stage for linking standard J or K type thermocouples to CUBAN-12A or CUBAN-12B analogue-to-digital converters. Each circuit provides a matched thermocouple connector to achieve optimal cold-junction compensation. The three stage amplifier first provides a gain to 10mV/°C, then a stable 40dB/decade low-pass filter to attenuate normal mode noise, and finally further gain, settable by trimpot or through one of the digital-analogue output channels on the CUBAN-12B.

THERM-I/O thermocouple interface - Type J	CE560AJ	£295.00
THERM-I/O thermocouple interface - Type K	CE560AK	£265.00

(Type J - Iron/Constantan : Type K - NiCr/NiAl. Both @ -20 to 800 °C)

Signal Conditioning Card Cables

CUBAN-12A works with any combination of TRANS-I/O and THERM-I/O, up to a total of four signal conditioning cards providing 16 channels. TRANS-I/O and THERM-I/O use the same cable in the same way. Connector spacing allows for side-by-side placing in a standard CUBE rack, and this is assumed with the following cables:

Signal Conditioning Cables for CUBAN-12A:		
Cable for One Conditioning Card	CC301AA	£17.00
Cable for Two Conditioning Cards	CC301AB	£20.00
Cable for Three Conditioning Cards	CC301AC	£23.00
Cable for Four Conditioning Cards	CC301AD	£26.00

CUBAN-12B works with any combination of TRANS-I/O and THERM-I/O, up to a total of two of these cards, plus one AMP-I/O if required. NB. The input circuits on AMP-I/O are alternative to, not additional to the input circuits on TRANS-I/O and THERM-I/O, to a maximum of 8.

Signal Conditioning Cables for CUBAN-12B:		
Cable for One AMP-I/O Card only	CC121BA	£17.00
Cable for One AMP-I/O Card only + One §	CC121BB	£20.00
Cable for One AMP-I/O Card only + Two §	CC121BC	£23.00
Cable for One § only	CC121TA	£17.00
Cable for Two § only	CC121TB	£20.00

§ Refers to either TRANS-I/O or THERM-I/O.

CUBAN-8
## Universal 8-bit Analogue and Digital Interface

(ADC+DAC)
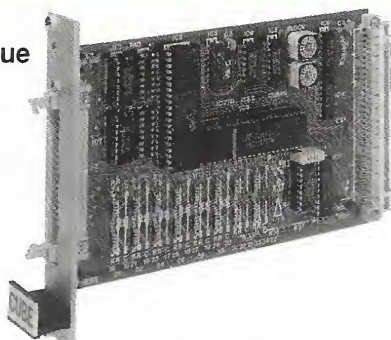
Sixteen 8-bit Analogue input channels - accuracy ± 1 lsb
One D-A output
On-board provision for resistor/capacitor signal conditioning
One 8-bit digital-analogue output channel
16 digital i/o lines + 4 control/handshake lines + 2 timers
40-way ribbon cable connector for all i/o
On-board provision for 8 switches and 8 LEDs for i/o simulation
Supported by EuroBEEB and EuroCUBE-09 software
Complete with front panel
Operates with 1 MHz CPUs only

| CUBAN-8 Analogue and Digital Interface	CE080AS	-150.00

CUBIO
80-way Digital Input/Output Interface
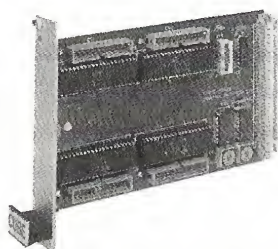
80 channel TTL level i/o interface, carrying up to four 6522 VIA devices
   Each VIA (Versatile Interface Adaptor) provides:-
      Port A - 8 i/o lines each with 1 LSTTL load capability in output mode
      Port B - 8 i/o lines each with 4 LSTTL load capability in output mode
      Line PB6 specialised for high speed counting
      Line PB7 specialised for high speed pulse generation
      Four control lines for generating interrupts
      Two timers of 16-bit accuracy
      As inputs, signals can be latched
   Each VIA is connected to the outside world by a 26-way ribbon cable
      connector of the same pin-out as CUBE cpu cards
CUBIO is fully address decoded so a large number of them can be
   supported in one system
Fully supported by Control BASIC, Real Time BASIC and EuroCUBE-09
   library modules
Complete with front panel

CUBIO TTL input/output interface (no VIA's)	CE800AU	£95.00
VIA Device (type 6522)	CP801VI	£5.00

READ-24
## Opto-isolated Digital Input Card
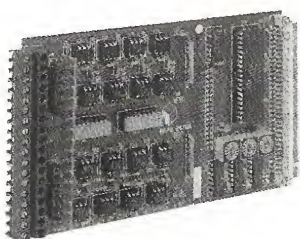
Sixteen channels of opto-isolated input from plant wiring
24V nominal working voltage; channels are individually user-alterable
   in the range 5V to 50V
Screw-terminal plant wiring block plugs into card without the need to
   disconnect individual wires
Accepts plant wires up to 2.5mm in diameter
LED status indication for each channel - can be detached and remotely
   mounted

Any four lines can be linked to generate interrupts
Two 16-bit programmable hardware timers
Pulse counter input
Fully supported by Control BASIC, Real Time BASIC and EuroCUBE-09
   library modules

READ-24 Opto-isolated digital input card	CE370AA	£170.00

POWER-50
Opto-isolated Digital Output Card
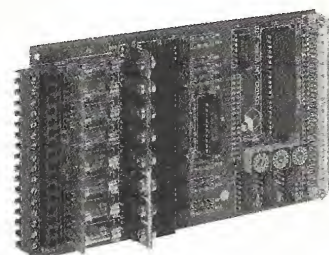
Eight channels of opto-isolated output to plant wiring
Up to 25V DC nominal working voltage switching up to 2A per channel,
   (1A continuous)
Screw-terminal plant wiring block plugs into card without the need to
   disconnect individual wires
Accepts plant wires up to 2.5mm in diameter
LED status indication for each channel - can be detached and remotely
   mounted
Each channel protected with replacable 20mm fuse
Pulse generator output
Two 16-bit programmable hardware timers
Fully supported by Control BASIC, Real Time BASIC and EuroCUBE-09
   library modules

POWER-50 Opto-isolated digital output card	CE360AA	£170.00

INDIO
Industrial Interface for High Voltage/High Current Input/Output
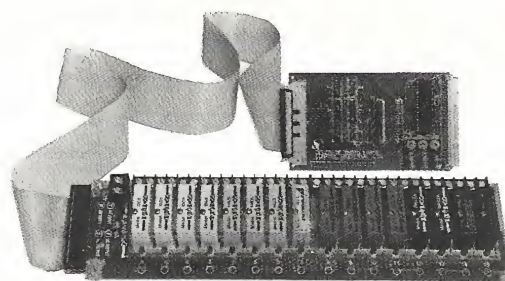
Interface card provides link to industry-standard high capacity i/o
   system
Drives up to 16 i/o channels
Outputs can switch 3A at up to 240V AC or 50V DC
Inputs can read signals at up to 250V AC or 50V DC
All units are opto-isolated to 4000V RMS
A system base can accept any mixture of inputs and outputs, and any
   mixture of working voltages
Each channel has:-
   pair of large industrial-style terminals;
   LED status indication
   overload fuse
INDIO has on-board definition of each channel as input or output

INDIO bus mounting interface card		CE132AA	£95.00
INDIO interface cable	1 metre length	CC130AA	£20.00
INDIO interface cable	2 metre length	CC130AB	£32.00
INDIO system base with 16 sockets		INI39AP	£99.00
IAC5 Input module 90 - 140 V AC		IN138AY	£12.00
IAC5A Input module 180 - 280 V AC		IN138AZ	£12.00
OAC5A Output module 24 - 280V AC		IN138BZ	£12.00
IDC5 Input module 3.3 - 32 V DC		IN138CW	£12.00
ODC5A Output module 5 -200 V DC		IN138DG	£12.00

SERIO
2/4-Channel
Serial Interface
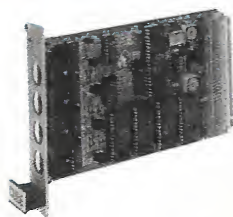
Four serial i/o ports on one card (choice of 2-channel version)
RS423 or RS422 on round 7-pin DIN connectors
Also communicates with RS232
Each channel has individually software programmable word format and baud rate in the range 50 to 19,200
Provision for terminating resistors and slew rate limiting capacitors
Provision for external baud-rate generator for non-standard receive-only baud rates
Eight digital i/o lines as standard VIA user port B
Fully supported by Control BASIC, Real Time BASIC and EuroCUBE-09 software library
Software support provides independent interrupt-driven serial buffers
Complete with front panel

SERIO - 2 channel serial interface	CE710AB	£175.00
SERIO - 4 channel serial interface	CE710AD	£195.00

CUBE IEEE
GPIB (IEEE-488)
Bus Interface

Full IEEE-488 Specification
Supported by convenient driver software for both EuroCUBE-09 and EuroBEEB
Full talker/listener capability
Can be controller or controlled from another computer
Standard GPIB bus drivers
LED status indication
Four sockets of paged memory in CUBE paged memory system (see CU-MEM Selecta for description)
Complete with front panel

The most popular use for CUBE with IEEE-488/GPIB is in laboratory use and test and measurement. Many of the instruments used in this sort of application have a GPIB interface (such as digital voltmeters, weighing machines, etc) and the convenience of CUBE systems in this environment (especially EuroBEEB) leads to very satisfactory quick solutions of integrated instrumentation and computing power. In addition, because the CUBE IEEE Card can be controlled, a further link may be made to another computer.

For EuroBEEB, the well established Procyon IEEE Filing System is used, which treats all data in and out of the card as if they were files, in the same way as a disk filing system would be used. This approach is very logical, unambiguous and easy to use. For EuroCUBE–09, a software utility is provided which permits data to be transferred between IEEE instruments and the computer.

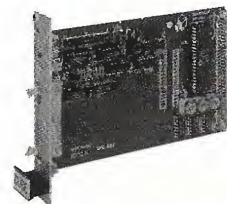|		
CUBE IEEE-488/GPIB Interface	CE880AA	£275.00
Procyon IEEE Filing System ROM	CP881AA	£75.00

CU-BUSEX
Bus extender
Card

Provides a means of working on a CUBE bus card outside the rack while maintaining connection with the backplane bus.

|		
CU-BUSEX bus extender card	CE040AA	£30.00

CUBE Watchdog
Systems
Healthy
Monitor

Hardware-programmable time-out from 2ms to 32.8 seconds
Steady green LED - system OK, Flashing red LED - system tripped
Audible warning upon system trip
Safety relay opens upon system trip - relay rating 30V/10W
Link selectable to trip NMI, IRQ, Reset or none of these
Full 16 line standard CUBE i/o port with same pin-out and capabilities as ports on EuroBEEB/EuroCUBE-09 and CUBIO (and supported by Control BASIC/RTB)
Complete with front panel

In applications where the integrity of continued processing is important, the Watchdog unit provides a fail-safe means of correcting systems failure. The technique employed is for the system program to write to the Watchdog memory location within a pre-set period. The user sets a link on the Watchdog to determine a time-out interval in the range 2ms to 32.8 seconds. If succesive write cycles to the Watchdog are not received during this time-out period, the LED displayed will change from green to flashing red, the audible alarm will sound, and the relay will drop out, so giving the opportunity to break a main system circuit breaker if desired. At the same time, according to the setting of another link, the IRQ, NMI, or reset line is operated. (The choice exists for none of these to occur.)

CUBE Watchdog	CE180AA	£129.00

CUPROM II
The Control Universal EPROM Programmer
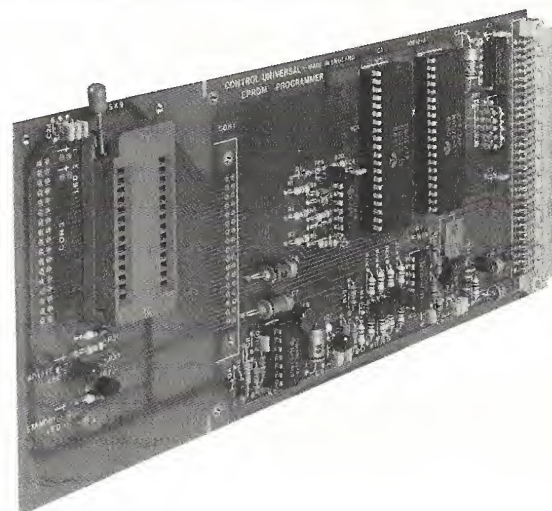
Programs 8k x 8 to 64k x 8 EPROMs ; 28-pin devices
Programs binary files from EuroBEEB
  IBM PC and BBC Micro/Master
Programs BASIC files on EuroBEEB
Programs, verifies and reads EPROMs
Automatic programming algorithms with status indicators
Accommodates 21V and 12.5V programming voltages

The new EPROM Programmer is a bus-mounting unit for use with EuroBEEB. Files can be programmed directly from memory or system disk. If the EuroBEEB is connected to a host IBM-PC, BBC Master or Micro, files from the host disk or memory can be programmed into EPROM. CUPROM II is supplied in a standard Eurocard design which plugs into the CUBE bus and has a 28-pin ZIF socket. The ZIF socket can either be mounted on the front of the card for easy access, or alternatively connected via a ribbon cable.

CUPROM II - 28 pin ZIF socket	CE281AA	£125.00

STE - The New <u>Standard</u>

High Performance Bus

STE has been rapidly accepted as the new standard bus for high performance small systems, with more than 30 manufacturers worldwide, of which the majority are in the UK. STE is in the final stages of adoption by the IEEE under P1000, the international standard for 8-bit bus systems.

The user gains the advantage of easy second sourcing of a strictly defined bus which is manufacturer and processor independent.

High Performance

1 Mbyte of address space permits complex applications, particularly large scale development work using compilers, and supports large high speed data storage and manipulation tasks.

Vectored interrupts, from up to 8 ATNRQ lines on the bus, allow a dramatic improvement in throughput in interrupt-based systems, as attention requests can generate pointers directly to the code to be executed, rather than requiring software polling to discover the source of the interrupt.

Multiprocessor capability allows a dedicated CPU to handle local i/o tasks without requiring access to the system bus, so improving the effective bus bandwidth in "worst case" real time situations.

Low Complexity

The performance advantages of STE have been achieved using a simple, asynchronous, non-multiplexed bus. The system designer can quickly and cheaply design special purpose cards and add them to a system of standard STE modules without compromising overall system perform-ance.

The *Celeste* Philosophy

The Celeste range is designed to exploit the performance advantages of the STE bus allowing the potential of the new generation of microprocessors and support chips such as the 80188, the 68008 and the 63484 graphics controller to be fully realised.

The IBM PC Link

The processor in the standard IBM PC is the Intel 8088. In certain PC compatibles it is the 8086, and in the IBM AT and its clones the 80286 is used. Celeste/188 is based on the 80188, whose relative level of integration is shown in the table.

| 8/16-bit	16/16-bit
	80286
80188	80186
8088	8086

↑ higher functionality

The versions with an external 8-bit data bus do essentially the same job as the 16-bit version, and in general they perform nearly as well, since the 16-bit internal architecture is identical in both cases. Real applications include a lot of internal processor work and 8-bit data handling which are both done at the same speed regardless of memory width. However, 8-bit versions offer compactness of memory use, more functionality on a given sized board, and a better cost/performance ratio.

Developing Real-Time Applications on the IBM PC

The IBM-PC, or compatible, is the ideal cost-effective software development support for Celeste/188. Application software may be written in the "C" language, then compiled to a run-time module to be downloaded, run and debugged on the Celeste/188. "C" run-time library functions and debugging monitor with MS-DOS compatible system calls are available for this purpose.

Celeste/188

High Performance 80188 Single Board Computer
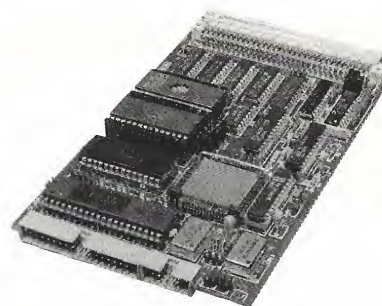
Features:

10 MHz 80188 processor with
   Twin independent high speed DMA channels
   Three 16-bit counter/timers
   16-bit internal architecture

1 MByte address space

Prioritised vectored interrupts under software control
   from all 8 STE ATNRQ lines and 11 CPU sources

Accepts byte-wide memory devices
   up to 128kB RAM plus 128kB EPROM

8256 MUART i/o device with
   Two 8-bit ports
   5 counter/timers
   RS423/485 serial port (RS232 compatible)

Full Bus arbiter with transparent multi-master operation

Link selectable bus master/slave configuration

Generates 2 ATNRQ signals for inter-processor communication

IBM PC/MS-DOS development support

'DEBUG' monitor available

Daughter board available with 8256 (providing additional serial port, 16 I/O lines, and timers) plus battery to support CMOS RAM

Version A: Accepts two byte-wide 28-pin EPROMs
   up to 64 KBytes each, plus one byte-wide
   28 or 32-pin RAM device up to 128 KBytes

Version B: Accepts one byte-wide 28 or 32-pin EPROM
   up to 128 KBytes, plus one byte-wide
   28 or 32-pin RAM device up to 128 KBytes

The following memory devices are supported:-

Device	Size	Pins
55256 CMOS Static RAM	32k x 8	28
5565 CMOS Static RAM	8k x 8	28
27128 EPROM	16k x 8	28
27512 EPROM	64k x 8	28
HM658128 Pseudo-Static RAM	128k x 8	32
27010 1Mbit EPROM	128k x8	32

External Connectors: 34-way IDC male header for parallel I/O, timers, external interrupt and power rails - (0V, 5V, ± 12V) plus a 14-way IDC male header for serial port

Board Dimensions: 100 x 160mm to STE IEEE P1000 specification.

Power Consumption: +5V, typically < 1000mA;
   ±12V, typically < 50mA

Celeste/188A - Duplex EPROM socket	SE024HA	£395.00
Celeste/188B - Turned-pin EPROM socket	SE025HA	£375.00

Celeste/008

**High Performance
68008 Single Board
Computer**
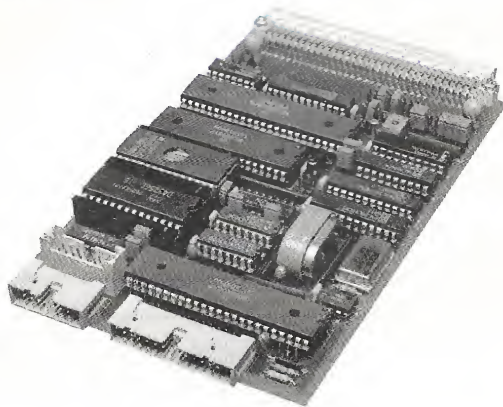
Features:

10 MHz 68008 CPU

32-bit internal architecture

1 MByte address space

Supports four bytewide memory devices to 192KB total

Two RS423/485 serial ports (RS232 compatible)

Two 8-bit digital I/O ports

Four control/handshake lines and one timer/counter input

16-bit and 24-bit programmable timer/counters

Real-Time calendar clock with alarm facility

Battery back-up circuit supporting RTC and CMOS RAM

Prioritised vectored interrupts supported for all 8 ATNRQ lines and 14 on-board sources

Full system controller and bus arbiter functions

Link selectable bus master configuration

OS9/68K development support

The following memory devices are supported:-
Version A: Accepts 4 byte-wide 28-pin memory devices
Version B: Accepts 2 byte-wide 32-pin memory devices

Device	Size	Pins
55256 CMOS Static RAM	32k x 8	28
5565 CMOS Static RAM	8k x 8	28
27128 EPROM	16k x 8	28
27512 EPROM	64k x 8	28
27010 EPROM	128k x 8	32

External Connectors: 26-way IDC male header for parallel I/O, timer input, handshake/control lines and power rails - (0V, +5V) plus two 14–way IDC male headers for serial port.

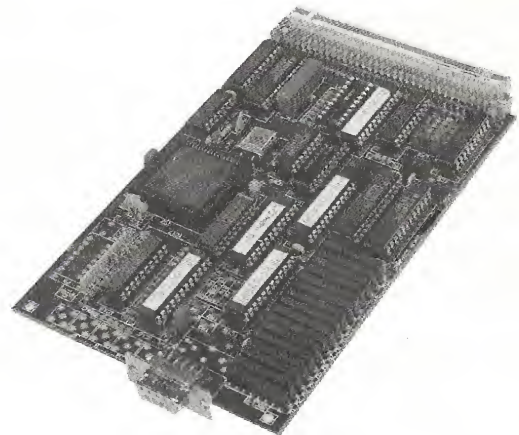**Board Dimensions:** 100 x 160mm to STE IEEE P1000 specification.

Power Consumption: +5V, typically < 1000mA; ±12V, typically < 50mA

Celeste/008A - Two 28-pin duplex sockets	SE011HA	£475.00
Celeste/008B - Two 32-pin turned sockets	SE012HA	£455.00

Celeste/484

**High Resolution
Colour Graphics**

Features:

Hitachi HD63484 Advanced Graphics Controller

512 KBytes on-board video memory

32 MHz INMOS G170 colour palette option

Powerful on-board graphics primitives

Resolution up to 1600 pixels by 1300 lines

Display rate up to 32 million pixels/sec

Fast plotting of complex lines, curves and area fill

Multiple screens and windows

Hardware zoom up to 16 times

Memory accessible from bus under DMA

Any number of windows and/or character fonts can be stored in non–displayed video memory

Celeste/484 is the powerful graphics processor card of the Control Universal range of STE cards. The Hitachi 63484 controller has three processors, one to manage the screen display, the second to manage all CRT timing functions, and the third to perform all the drawing operations. Commands supported directly via simple parameters include circle, ellipse, polyline, arc, paint, etc. A choice of screen access modes allows either full resolution (by drawing only during flyback) or higher drawing speeds by interleaving screen display and drawing times. Up to 1600 pixels can be displayed horizontally with standard 15.75 kHz line rate monitors. Other resolutions are obtainable under software control or by changing the pixel clock frequency.

Version A has the INMOS colour palette allowing a choice of 256 colours from 262,144. Selected colours may be flashed at variable rates. Different palettes may be loaded from the host CPU. Output drives analogue or TTL monitors.

Version B has no colour palette and drives TTL monitors only.

External Connectors:
Version A: 5 SMB 'subclic' coaxial connectors for analogue monitors.
Version B: 9-way standard mini "D" type connector providing RGBI and Sync for TTL monitors.

Board Dimensions: 100 x 160mm to STE IEEE P1000 specification.

Board Power Consumption: +5V, typically < 1000mA

Celeste/484A - With INMOS colour palette	SE485AA	£765.00
Celeste/484B - No INMOS colour palette	SE484AA	£595.00

Celeste/772   Intelligent Disk Controller

WD 1772 Controller, supports up to four 3¹/₂" or 5¹/₄" drives

Intelligent on-board 8K/32K sector/track FIFO buffer

Single or double density recording

Data transfers between disk and buffer under local DMA control, maximizes speed and eliminates real-time interrupt overhead

Digital data separator requires no adjustable or temperature sensitive components, ensuring reliable and stable operation

Vectored interrupts fully supported for transfers between FIFO buffer and system memory

Address space occupies only 16 bytes, switch selectable anywhere in I/O space

OS9/68K drivers available

Celeste/772 Intelligent FDC with 8K buffer	SE772AA	£185.00

Celeste/101   1 MByte Dynamic RAM

Upper and lower address limits link or software selectable on 64K boundaries, allowing complete flexibility in memory mapping

Paged operation allows RAM Disk to be configured using multiple cards up to 20 MBytes

DRAM refresh and timing completely transparent to system

Link selectable DATACK* delay from 62.5nS to 375nS

Uses industry standard 256K memory devices

4-layer PCB construction for high noise immunity

Available in 512K and 1 MByte versions

Celeste/256A - 1 MByte Dynamic RAM	SE256AA	£345.00
Celeste/256B - 512 KByte Dynamic RAM	SE256AB	£275.00

Applications Development Support

Celeste/68K Development Systems

Celeste/68K-TF: 10 MHz Celeste/008 CPU. 1 MByte DRAM, twin 3¹/₂" floppy disk drives providing 1.28 MBytes capacity, 2 x RS423 (RS232 compatible) serial ports, 2 bi-directional parallel ports, battery–backed real-time calendar clock and full system bus controller/arbiter functions. Prioritised vectored interrupts supported on all 8 STE bus ATNRQ lines. Memory expansion up to 12 MBytes total. 11 slots available for additional STE cards. Industry standard 19" rack-mounting sub-unit, with 200Watt 3-rail power supply, housed in smart metal enclosure.

Celeste/68K-HD: As model 68K-TF, except one 3¹/₂" floppy disk drive is replaced by a 20 MByte Winchester Disk. A full SCSI interface is incorporated, with twin DMA channels and a 32 KByte FIFO buffer, allowing data transfer rates in excess of 1 MByte/sec. One DMA channel is available for system use. External SCSI devices are supported. (Available 3rd Quarter '87).

Both supplied with Professional OS9/68K Version 2.0 Operating System. Compatible with UNIX at the "C" source code level. Supports efficient ROMable target code in real time multitasking environment. The professional package includes "C" compiler, symbolic assembler/debugger, full screen editor, and extensive utility package, including ROM/RAM disk capability. Networking is a fully supported option for distributed systems.

Celeste/68K -TF System with Twin Floppy	SR688PL	£2375.00
Celeste/68K -HD System with Hard Disk	SR689PL	£2975.00

Wyse-30 Serial Terminal	TS030WY	£445.00

Celmon/008 Debug Monitor for Celeste/008

Based on Motorola's VME bug, this machine code monitor for Celeste/008 includes a powerful debugging command set. Terminal and File Upload/Download capability, plus resident assembler/disassembler.

Celmon/008		
Machine Code Monitor for Celeste/008	SS210AA	£95.00

Celmon/188 Debug Monitor for Celeste/188

This machine code monitor for Celeste/188 provides facilities for uploading/downloading code from the IBM PC or compatible and a comprehensive range of debugging utilities based on the command set of the IBM DEBUG Package. It also provides MS-DOS compatible system calls to service routines.

Celmon/188		
Machine Code Monitor for Celeste/188	SS288AA	£95.00

Celrun/188 "C" Runtime Library for Celeste/188

Celrun/188 is a disk library of functions and utilities to support the Celeste/188, including i/o and startup facilities, intended for use with the Aztec "C" development language running on the IBM PC or compatible.

Celrun/188 "C" Celeste/188 Runtime Library	SS388RL	£95.00

Aztec "C" Development Language for IBM PC

Full spec (Kernigham & Ritchie) "C" compiler, supporting 8086/80186 instruction set. Overlays and large memory programming model supported. Text editor and development utilities are provided. Assembly code can be incorporated in-line, or linked from separate modules. Powerful symbolic debugger is included. Generates completely ROMable code.

Aztec "C" Development Language	SS861AA	£250.00

Celbox/005 Five-slot STE Rack

Fully enclosed rack with 5-slot STE backplane and 3-rail power supply (5V and ± 12V), prewired with IEC filtered mains input.

Celbox/005 Five-slot powered STE Rack	SR305GG	£345.00

Celcab/IBM Serial Communication Cable for Celeste/188 to IBM PC

Provided with 25-way D connector at the IBM end and 14-way IDC connector at the Celeste end, the serial cable is 2m long.

Celcab/IBM Serial Cable IBM-Celeste	SC188CC	£25.00

Celeste/80K Development Workstation for IBM PC

A five-slot system for STE applications development on the IBM PC includes:-

- **Celeste/188** with 32 or 128 KBytes RAM
- **Celmon/188** - debug monitor with MS-DOS system calls
- **Celrun/188** - utilities library for use with Aztec "C"
- **Celbox/005** - 5-slot STE rack with power supply
- **Celcab/IBM** - serial cable from Celeste/188 to IBM PC
- **Celcom/IBM** - Terminal utility for the IBM PC

Not included are the IBM PC or compatible, or the "C" compiler, as the user may have these or alternatives already.

Celeste/80K-A with 128 KBytes RAM	SR188AA	£945.00
Celeste/80K-B with 32 KBytes RAM	SR188BA	£895.00

Hexatron PromDOS 2.01
80188 Development Environment

MS-DOS compatible software system for Celeste/188, providing support for programs developed in "C" or Assembler on the IBM, allowing .EXE files to run without modification on the target system. Facilities for ROM and RAM disk are incorporated with simple file handling, providing a solid state MS-DOS compatible system on a single board. Extensive debug and testing support includes full a debug package (with TRACE facility), simple BASIC interpreter, line assembler/disassembler. Other utilities include .EXE to .BIN conversion, ROM disk file creations for EPROM programmer, terminal support, and many others. Supplied with comprehensive manual.

Hexatron PromDOS 2.01	SS289AA	£545.00

Courses - now with free product vouchers

Control Universal run a number of successful courses on CUBE products, and have received many favourable comments on the usefulness and the high standard of these presentations.

Courses are run on an "as required" basis, either as a sufficient number of requests are received from a variety of organisations, or at the request of one organisation. Courses can be held in our well-equipped Conference Centre at Cambridge Head Office, or else at the customer's premises or other agreed location.Courses at Cambridge - daily rates: £160.00 for the first delegate from any organisation, £140.00 for the second delegate, and £120.00 for each subsequent delegate.

For courses at other locations, add 15% to the above charges. For exclusive courses there is a minimum charge of £450.00 per day, plus £100.00 per delegate, plus any expenses (hotel accommodation, travel, etc.) that are necessarily incurred. A voucher is issued to each participating organisation for $1/3$rd of the fees actually paid (excluding expenses) which can be redeemed against subsequent Eurocard purchases.

Recommended Courses: These courses can be combined as required, and exclusive courses will, of course, be matched to the client's requirements.

Programming for Control Applications on EuroBEEB	
BBC BASIC and Control BASIC	1 DAY
Real Time BASIC and Control Net	1 DAY

Analogue Measurements and Signal Conditioning	1 DAY

Programming on 6809 with P/L9	1 DAY
Programming on 6809 with "C"	2 DAYS

Real Time Applications Programming in "C" under OS9/68K	2 DAYS
Real Time Applications Programming in "C" under MS-DOS	2 DAYS

Third Party Products

Control Universal is a manufacturer of its own designs, not a distributor for other companies. However , a limited range of third party products is available where these contribute to the convenience of the customer; that is the cornerstone of our sales policy. The third party products currently available, are listed below.

Tandon PCX10 - 360kB floppy + 10MB H/disk	IB100XT	£1295.00
Tandon PCA20 - 1.2MB floppy + 20MB H/disk	IB200AT	£1995.00
Other PC variants of Tandon are available. Please enquire.		

BBC Master 128	BBAMB15	£435.00
Boxed twin 3 1/2"disk drive unit	CD382TF	£242.00
Boxed twin 5 1/4" disk drive unit	CD582TF	£340.00
Softlife EPROM programmer	EP270SL	£72.00
Microvitec 14" std resolution RGB Monitor	MC014MS	£219.00
Microvitec 14" medium resolution RGB Monitor	MC014MM	£265.00
Microvitec 14" high resolution RGB Monitor	MC014MH	£445.00
Zenith 12" monochrome monitor	MM012ZG	£95.00
Epson LX86 Printer	PR086AF	£255.00
Tractor Feed for LX86	PR086TF	£20.00
Epson FX85 Printer	PR085AF	£438.00
Tractor Feed for FX85	PR085TF	£32.00
Centronics Printer Cable	CC000PC	£22.00

Technical Manuals

Each card ordered at full price is supplied with its own manual free of charge (see page 3), and only in special cases is there a charge for a product manual. § The prices below are for copies supplied without Eurocards or with products supplied at discounted prices.

CUBE TECHNICAL MANUALS

A5 PVC Ring Binder for all CUBE Manuals	CB000AA	£10.00
MINIRACK Technical Manual	CB001TM	£5.00
CU-MEM Technical Manual	CB052AA	£5.00
CU-MEM Selecta Technical Manual	CB053AA	£10.00
CU-PRINT Technical Manual	CB070AA	£5.00
CUBAN-8 Technical Manual	CB080AA	£10.00
EuroCUBE-09 Technical Manual	CB090AA	£15.00
CUBEFLEX Technical Manual	CB093AA	£15.00
BEEBFLEX Technical Manual	CB096AA	£10.00
6809 Peripheral Drivers Technical Manual	CB098AA	£15.00
SILICON DISK Technical Manual	CB099AA	£5.00
CU-GRAPH Technical Manual	CB111AA	£15.00
CUBAN-12B Technical Manual	CB120AA	£15.00
INDIO Technical Manual	CB132AA	£10.00
BACKPLANE Technical Manual	CB142AA	£5.00
WATCHDOG Technical Manual	CB180AA	£5.00
DOUBLESTORE Technical Manual	CB200AA	£10.00
RACKPRINT Technical Manual	CB240AA	£5.00
BEEBEX Technical Manual	CB270AA	£5.00
CUBAN-12A Technical Manual	CB300AA	£15.00
CUPROM II Technical Manual	CB281TA	£15.00
POWER-50 Technical Manual	CB360AA	£10.00
READ-24 Technical Manual	CB370AA	£10.00
TELETEXT Technical Manual	CB400AA	£10.00

VIEWLINE Technical Manual	CB480AA	£5.00
JOBBER InterfaceTechnical Manual	CB490AA	£15.00
EuroBEEB Development Workstation Manual	CB612UG	£15.00
Analogue Data Capture Unit Technical Manual	CB661AA	£10.00
Control Forth Manual	CB652BF	£15.00
Real Time BASIC Manual	CB652BR	£25.00
Sidemon Manual	CB654TA	£10.00
BASIC IV Manual	CB657TA	£25.00 §
EuroBEEB Manual	CB660AA	£25.00
EuroBEEB Operating System Manual (MOSB4)	CB664AB	£25.00
EuroBEEB Advanced O/S Manual (MOSB4)	CB665AA	£25.00
AutoMOS4C Technical Manual	CB668TA	£10.00
AutoMOSB4 Technical Manual	CB668TA	£10.00
Control NET Technical Manual	CB667TM	£25.00
SERIO Technical Manual	CB710AA	£10.00
CUBIO Technical Manual	CB800AA	£5.00
IEEE INTERFACE Technical Manual	CB880AA	£15.00
CUBE PROTOTYPING Technical Manual	CB907AA	£5.00
Opto-isolator Technical Manual	CB910AA	£5.00
CU-KEY-99 Technical Manual	CB999AA	£5.00

§ The BASIC IV Manual is F.O.C. with EuroBEEB development packs but otherwise is only avaliable at extra cost.

Celeste Technical Manuals

Celeste/188 Manual (80188 CPU)	SB021TA	£25.00
Celeste/008 Manual (68008 CPU)	SB011TA	£25.00
Celeste/484 Manual (High-res video)	SB484TA	£25.00
Celeste/772 Manual (disk controller)	SB772TA	£15.00
Celeste/101 Manual (DRAM)	SB256TA	£15.00

Terms & Conditions of Business

TERMS AND CONDITIONS OF BUSINESS

1. PRICES. All prices quoted are exclusive of VAT. Currently 15% is charged on all items except books, which are zero rated. Products which include documentation have VAT levied on the whole price of the product. Prices shown in printed literature are for guidance only; the price charged will be that ruling at the time of delivery.

2. DELIVERY CHARGES. Postage, packing and insurance charges are added to credit card and credit account orders, but are free on UK mainland orders paid in advance.

3. PAYMENT. In addition to cheques, Access is accepted as payment on most goods. Credit accounts are opened on the strict understanding that invoices will be paid within 30 days of presentation. The payment terms must be observed for all goods delivered, and there is no entitlement to delay payment on the grounds that an order is not complete.

4. DISCOUNTS. Where discounts have been allowed, these are conditional on the account being settled in full by the thirtieth day after delivery. Where payment is not received by the due date, the discount will be irrevocably cancelled.

5. COMPLAINTS. Any complaint with respect to any part of the order will be judged on its merit, and the above rules concerning payment and discounts will be suspended during investigation. However, these terms of business will apply to the whole of the rest of the order, and the suspension will apply to the article in question only.

6. TITLE. Control Universal Ltd. retain title to all goods until paid for in full. The customer is however, responsible for the goods, and will be held liable for any loss, damage or destruction. This liability commences immediately upon receipt.

7. COPYRIGHT WARNING. Copyright restrictions exist on all hardware designs and software in products sold by Control Universal Ltd. The price paid entitles the purchaser to make use of or sell the item bought but does not include the right to make any copies.

8. GUARANTEE. All products sold by Control Universal Ltd. are guaranteed for one year from the date of delivery, and will be replaced or repaired in the event of a failure being due to the supply of faulty materials or workmanship by Control Universal Ltd.

9. LIABILITY. All sales are made by Control Universal Ltd. on the strict understanding that all liability for any consequential loss is excluded.

Disclaimer. Prices may be subject to change without notice, and these prices do not constitute an offer for sale.

Conditions. All supply of goods will be governed by Control Universal Ltd. **Terms and Conditions of Business**, shown above, which are also published on the Credit Account Opening Form, and on the reverse of Quotations, Acknowledgements and Invoices. Credit Account Opening Forms may be obtained from Regional Sales Engineers or direct from Head Office. These must be completed by all customers, even those "blue chip" accounts to whom we give automatic credit facilities. Control Universal Ltd accepts orders only under the above Terms and Conditions of Business, and not on Customers' Terms of Purchase.

Local Sales Support in your Area

Where's my engineer ? Wherever you are in Britain and Ireland, there is a regional sales engineer covering your area. The map on the inside front cover shows the different regions, and below we have included a list of the main postal districts grouped by engineer.

North Area
Isaac Schalom

BB	Burnley
BD	Bradford
BL	Bolton
CA	Carlisle
CH	Chester
CW	Crewe
DH	Durham
DL	Darlington
FY	Blackpool
HD	Huddersfield
HG	Harrogate
HU	Hull
HX	Halifax
L	Liverpool
LA	Lancaster
LL	Clywd
LS	Leeds
M	Manchester
NE	Newcastle
OL	Oldham
PR	Preston
SK	Macclesfield
SR	Sunderland
ST	Stoke
SY	Montgomery
TF	Shropshire
TS	Cleveland
WA	Warrington
WF	Wakefield
WN	Wigan
YO	Yorkshire

Plus all postcode areas in Scotland and N. Ireland.

West Area
Ken Fullbrook

BA	Bath
BH	Bournmouth
BS	Bristol
CF	Cardiff
DT	Dorchester
EX	Exeter
GL	Gloucester
HR	Hereford
LD	Radnor
NP	Newport
PL	Plymouth
RG	Reading
SA	Swansea
SL	Slough
SO	Southampton
SP	Salisbury
SN	Swindon
TR	Truro
TA	Taunton
TQ	Torbay

Central Area
Mark Hassell

B	Birmingham
CV	Coventry
DE	Derby
DY	Kidderminister
DN	Doncaster
HP	Buckingham
LE	Leicester
LN	Lincoln
LU	Luton
MK	Bedford
NG	Nottingham
OX	Oxford
PE	Peterborough
S	Sheffield
WR	Worcester
WS	Walsall
WV	Wolverhampton

East Area
Mark Portlock

AL	St Albans
CB	Cambridge
CM	Chelmsford
CO	Colchester
EN	Enfield
HA	Harrow

IG	Ilford
IP	Ipswich
NR	Norfolk
RM	Romford
SG	Stevenage
SS	Southend
UB	Uxbridge
WD	Watford

South East Area
Dennis Murphy

BR	Bromley
BN	Brighton
CR	Croydon
CT	Canterbury
DA	Dartford
GU	Guildford
KT	Kingston
ME	Medway
RH	Redhill
SM	Sutton
TN	Tonbridge
TW	Twickenham
PO	Portsmouth

Plus all postcode areas in London.

Control Universal Ltd

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